THE STUDENT'S GUIDE

TO THE

PRACTICE OF MEASURING AND VALUING

ARTIFICERS' WORKS.

NEW EDITION.

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THE STUDENT'S GUIDE

TO THE

PRACTICE OF MEASURING AND VALUING ARTIFICERS' WORKS:

CONTAINING

DIRECTIONS FOR TAKING DIMENSIONS, ABSTRACTING THE SAME, AND BRINGING THE QUANTITIES INTO BILL;

WITH

Tables of Constants, for Valuation of Labour.

ORIGINALLY EDITED BY

EDWARD DOBSON, ARCHITECT.

NEW EDITION,

WITH ADDITIONS ON MENSURATION AND CONSTRUCTION, AND SEVERAL USEFUL TABLES FOR FACILITATING CALCULATIONS AND MEASUREMENTS,

BY

E. WYNDHAM TARN, M.A., ARCHITECT,

AUTHOR OF 'THE SCIENCE OF BUILDING,' ETC.

With Nine Plates and Forty-seven Woodcuts.

LONDON:

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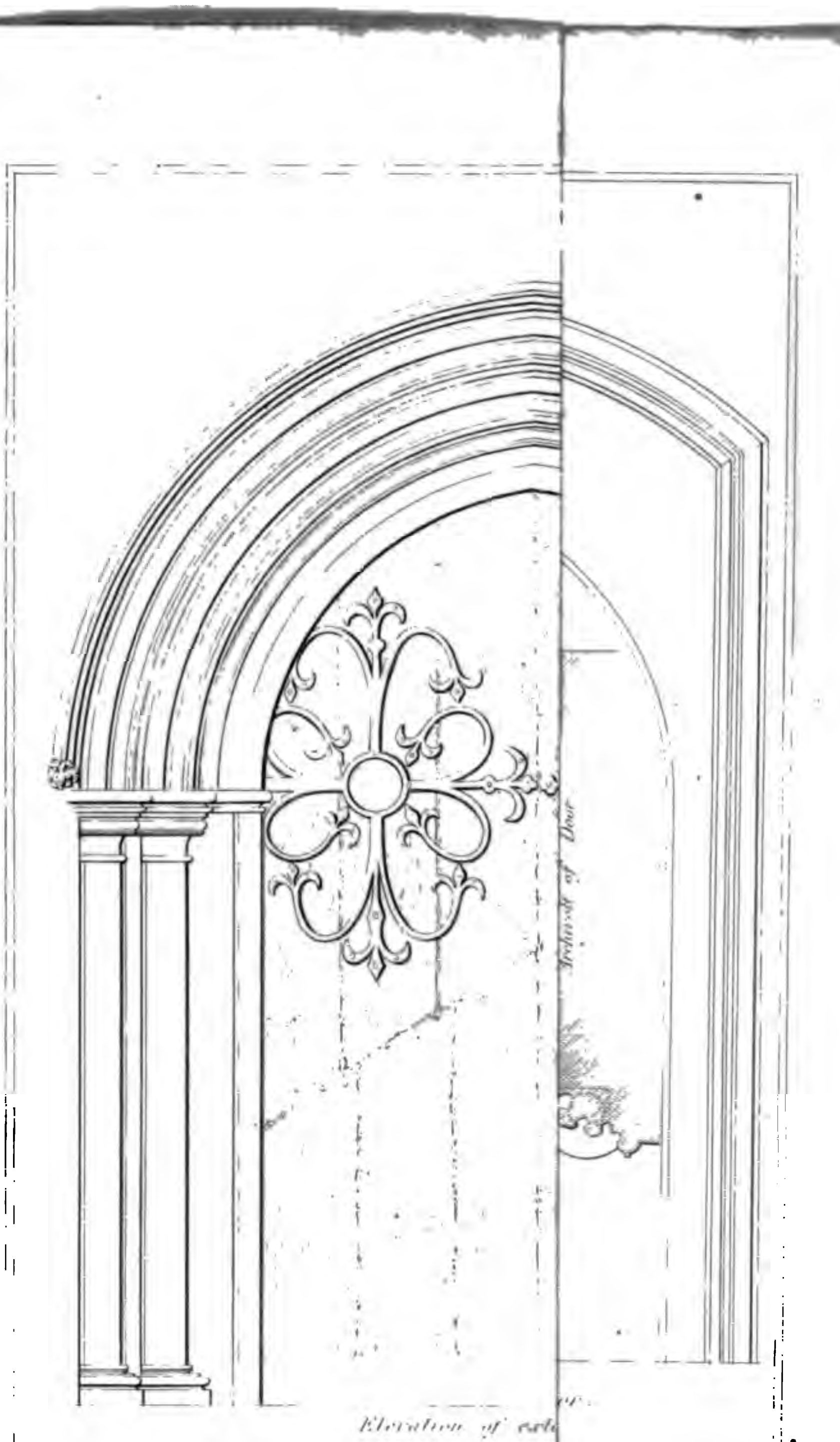

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PREFACE.

THE following work is based upon one published many years since, which was originally written expressly for the rising student by an eminent architect and surveyor of upwards of fifty years' experience; and the manuscript having been left at his death in an imperfect state, was carefully arranged for publication with much additional matter, by Mr. E. Dobson. For a long time it has been the only standard guide to the methods employed by surveyors in their measurement of builders' works, and the various rules which are laid down have been generally accepted as the safest that can be adopted with a view to obtaining an accurate estimate of their cost.

In the present edition the work has been entirely revised, and a large amount of information added with respect to the technicalities and modes of construction employed in the several trades; for no one can be a skilful measurer of work done by artificers, unless he makes himself thoroughly and practically conversant with the processes which they adopt in executing their works.

With this object in view the present editor has endeavoured not only to make the student acquainted with most of the technicalities used in building operations, but also to explain, as far as the scope of the work would allow, the manner in which those operations are carried on. The student will also find rules given for ascertaining the strength of substances used in building, as well as the weights of most of those which come under the title of *building materials*.

The Introduction, explaining the object and plan of the work, was written by the original author, and the remarks therein contained are left without alteration as they appeared in the first edition.

The first chapter contains an explanation of the methods employed by surveyors for reducing superficial and cubical measurements by help of the branch of arithmetic called duodecimals; and tables are annexed by which much of the labour of this reduction is saved. It is, however, recommended to the student to practise the art of 'squaring dimensions,' without any aid from the tables, and only to refer to them for the purpose of testing the accuracy of his calculations. In this chapter are also given rules for finding the area, circumference, and solidity of various geometrical figures commonly met with in buildings; these will be found useful in measuring many branches of artificers' work.

The second chapter treats entirely upon the dig-

ging and well-sinking required in building operations, explaining how the quantity of earth excavated can be ascertained, and the value of the labour thereon estimated.

In the third chapter the operations of the bricklayer are noticed, also the materials used in his work, and the mode in which that work is executed: the several terms used by bricklayers are also explained, and the usual system of measuring and valuing employed in this branch of trade is set forth. The modes of manufacturing concrete and the several uses to which it is applied, are described in this chapter, together with the rules for its measurement. The processes of laying and measuring the tiling and slating to the roofs of buildings are also given, with the sizes, weights, &c., of the several varieties of tile and slate employed.

The work of the carpenter and joiner is treated upon in the fourth chapter, the several processes used by those artificers being described and the terms which they employ explained. Under the head of 'Carpentry' will be found a description of the modes of framing floors, roofs, &c., and rules are given for ascertaining the strength of timbers and their proper scantlings according to the manner in which they are strained. Under the head of 'Joinery' will be found a notice of the several terms used by joiners in fitting pieces of wood together, and a description of the methods they employ for that

purpose. The measurement and valuation of joiners' work is more intricate than that of any other trade: it is here fully gone into, and it is hoped, made clear to the student; but great care is necessary on the part of the measurer in this branch of work, especially when he is taking off the 'quantities' from a set of plans for a building not yet erected. The work must be thoroughly analysed in order to get at the true value of each part.

In the fifth chapter the student will find a description of the methods of working in stone, to which the term 'Masonry' is applied, with a short account of the various kinds of stone usually employed in England, their qualities as to durability, hardness, weight, and strength. The principles by which the surveyor is to be guided in measuring masons' work are fully laid down.

The sixth chapter is devoted to an explanation of the several works which come under the name of 'Plastering,' together with the methods by which the cost of such work is usually estimated.

The employment of iron in the erection of buildings of every description has increased very greatly during the last few years, rendering it necessary that the student of architecture should be thoroughly conversant with its several qualities. In the seventh chapter will be found an account of the various forms in which that valuable material is now employed in building operations, together with rules for ascer-

taining its strength under different arrangements of load, and its weight according to shape and size. Instructions for the valuation of iron-work are also given. Ironmongery and bell-hanging are treated upon in the same chapter.

In consequence of the extensive introduction of slating as a covering for the roofs of houses, lead has been nearly discarded for that purpose except for those which have a very low pitch, or are nearly flat; and even then other materials, such as asphalte and cement, are often used in preference. In a few ancient buildings which have escaped the ravages of time, we find roofs covered with lead of very great thickness; but generally the lead has been stripped off and melted down on account of its value, especially in times of war and revolution, when the great demand for that metal has enhanced its price; and even in peaceful times it is no uncommon thing to find lead stolen off the roofs of buildings. What little lead-work there is now done on roofs is explained in chapter eight, under the title of 'Plumbing,' which term, morever, includes everything connected with laying-on water-pipes throughout a building. The employment of zinc for roofing purposes is increasing considerably, its peculiarities and the proper manner of treating it being now understood; and for an inexpensive and light kind of roofing there is no material which can compare with it. As the mode of using zinc is very similar

to that of using lead for roofing purposes, its description is introduced in the chapter on plumbing. A short account of gas-fitters' work is also appended to the same chapter.

The finishing or ornamenting of the interior of a house is placed in the hands of the 'Decorator,' whose work begins after all the other workmen have left. The work of the decorator, which is treated in chapter nine, includes painting, colouring, papering, fresco, scagliola-work, mosaic-work, looking-glasses, and also the application of variously coloured marbles as in panelling, paving, or chimney-pieces. This branch of work is usually executed in first-class houses by persons who have nothing to do with the erection of the building; and before being commenced the building should be allowed to stand some months after it has left the builder's hands, in order that it may get thoroughly dry and the work settled. The various kinds of glass used for building purposes are also described in this chapter, under the heading of glaziers'-work.

The tenth chapter contains information on various matters connected with the erection of buildings, which cannot be classed under any especial trade; such as the warming and ventilating of rooms either by open stoves, close stoves, hot-air or hot-water apparatus, &c.; revolving and coiling shutters; lightning-conductors; asphalting, &c.; each and all of which may be considered as forming separate branches

of trade. These matters are generally undertaken by parties who are quite independent of the contractor for the main building, but they are sometimes included in his specification ; for although there are many advantages arising from employing one general builder to carry out the whole of the work to be done in erecting an edifice, yet it is advisable that such matters as decoration, warming, ventilating, which do not interfere with the main structure, or for which provision can easily be made during its progress, should be executed separately, either under contract or otherwise, by parties who give those subjects their special attention, the work being generally in that case better done, as the party employed has his own reputation at stake; whereas if only a sub-contractor under the general builder, he does not feel responsible to the person for whom the building is erected for any defects or inferiority of workmanship. In many parts of the country each trade is executed by a separate contractor; but this plan, although perhaps more economical than that of employing a general contractor, is not always satisfactory, as the works done by the several trades will not fit properly together, and it may sometimes happen that part of the work remains incomplete, from a want of agreement between the workmen as to which branch of trade it actually belongs. In the modern system of large contracts commonly adopted in the principal towns, we go to

the opposite extreme, and place everything connected with a building in the hands of one firm; consequently the cost of building is generally higher in large towns than in the country, and the workmen take less interest in turning out good work than they would do if directly responsible to the employer, and having the full credit of it when executed.

The prices of labour vary considerably in different parts of the country, the wages of the men being generally higher in London and other very large towns, where board and lodging are dear, than in the smaller towns and villages, in which they are comparatively cheap. It is therefore necessary, in valuing artificers' work, to take into consideration the locality in which it is executed, and not to attempt to fix one arbitrary price for the whole country. The cost of building also greatly depends on the goodness or badness of the roads leading to the work; and if goods can be brought near the site, either by canal or railway, much expense is saved; as also, if the heavier materials, as stone, brick, lime, sand, or timber, can be readily obtained on the spot or in the immediate locality, since the *leading* or carting of these greatly affects the cost of the building. Inasmuch as the use of water enters largely into the several works, a good supply should be obtained before commencing any building operations, the cost of carrying water any great distance amounting to a considerable item in the expenses; for which purpose,

when a building is erected in the country, the sinking of a well is the first thing to be attended to, if there is no other supply of water close at hand.

It may be taken as a general rule, in erecting buildings in various parts of the country, that the materials, whether stones or bricks, slates or tiles, which are found most convenient to hand should be made use of as far as possible, and that the local workmen should be employed thereon, as they are generally better acquainted with the peculiarities of climate and locality and the working-up of the local materials than men brought from a distance can be. Until very recent times every county in England may be said to have had its own especial style of building, arising partly from the nature of the materials found in the locality, and partly from peculiarities in the climate. In the present day, owing to the rapidity and ease with which various materials are conveyed from place to place, these peculiarities are to a great extent disappearing in the better class of buildings, and a greater similarity is found to pervade them than formerly was the case; and as the workmen employed on such buildings can now be moved about much more easily than in former times, their provincial prejudices and peculiarities have become considerably modified. On this account the methods of building and of measuring artificers' works have become greatly assimilated all over the kingdom, so as to admit of

one general standard being everywhere adopted, with slight modifications as circumstances require. It is therefore believed that the present work will be found of equal value to students, whether training in the offices of provincial surveyors and architects or in those of London practitioners.

Since the admeasurement of obstructions to 'ancient lights' forms an important part of the business of the surveyor, an account of the methods to be adopted in determining the loss of light by such obstructions is given at the end of the volume, together with tables for facilitating calculations.

E. W. T.

LONDON:
34 *Mecklenburgh Square.*
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THE PRACTICE

OF

MEASURING AND VALUING ARTIFICERS' WORK.

INTRODUCTORY CHAPTER.

PRELIMINARY OBSERVATIONS.

THE AUTHOR,* having retired from the profession, has been enabled to devote considerable time to the preparation of the present work, which is intended for the information of the young student in a department which, in some respects, is not the most pleasant part of the architect's duty; more particularly when it is one to which he does not feel himself perfectly competent, which is the case if he has not had the opportunity, or has neglected to avail himself of the means, of obtaining the requisite information. It is therefore strongly recommended to the student, that, after he has acquired sufficient knowledge of construction for making out working drawings correctly, he should attend to the rules by which, in due time, he may

* The MS. of this work was originally prepared by an eminent surveyor of fifty years' experience, after whose decease it was arranged for publication by Mr. E. Dobson.—E. W. T.

become qualified to measure and value the work when performed. The disinclination often felt by young gentlemen of education for the study of these rules, and of the mechanical part of the profession, make it the more necessary to impress on their minds the absolute necessity of studying these essential qualifications,—which can only be done with any probability of success, by commencing at the lowest, and rising gradually to the higher departments. If the student neglects the operative part, he must never expect to be capable of making working drawings without incurring the ridicule of the mechanic; and when he commences business on his own account, if he also neglects the measuring department, he will be obliged to employ persons to make out his specifications, and to measure and value his works when completed. The expense incurred by thus employing others to do what he is incapable of, is a minor consideration; for it is imperative on the young architect to reflect that he will be the responsible agent between the gentleman and the builder, and that if, during the erection of an edifice, he allows the work to be insecurely performed, or suffers his employer to be imposed on, not only is his character at stake, but he is also amenable to the laws of his country (and very properly); so that following the profession of an architect, not being duly qualified, may be attended with the most serious consequences; for whether an architect allows his employer to suffer from inattention on his own part, or from the ignorance or dishonesty of the persons employed by him,

it is precisely the same in effect, he being professionally employed, and receiving his commission on the cost of the building, which is paid him for designing, directing, and superintending its construction, and seeing that the whole is performed in a proper and workmanlike manner, examining and passing the accounts, and making every arrangement for their final settlement. Consequently, in case of failure in any respect, he is answerable, from whatever cause it may arise, except the improper interference of his employer. Independently of this serious responsibility, if he does not qualify himself in the operative part, it is impossible that he can ever follow his profession with any comfort or satisfaction. Even in passing over or through his own buildings, he is obliged to be most careful of giving any directions, fearful lest he should commit himself before the common mechanic, who very soon discovers if the architect has practical knowledge, and consequently in what manner the work may or must be done, and acts accordingly.

It may be stated that architects of extensive practice cannot attend to all these things themselves. True; but be it remembered, that young men do not very soon get into such practice, particularly if they are not well qualified; and when they do, it is the more essential that they should perfectly understand the practical part of their profession,—that they may select proper assistants, and having chosen them, that they should know from their own experience if they perform their duty with ability and integrity.

This treatise was commenced originally for the purpose of giving the pupils studying under the author, who had an extensive country practice, a correct idea of measuring, abstracting, bringing into bill, and valuing the different artificers' works, agreeably to the methods considered by London surveyors as the most correct and expeditious. The great talent and extensive practice of metropolitan surveyors must be allowed as sufficient authority for concluding that the rules laid down by them are superior to any others that can be adopted. Independent of which, it being the practice for the architect, or his clerk or surveyor, to meet the surveyor appointed by the tradesman to take the dimensions, abstract their contents, make out the quantities into bill, and value the work together, it is absolutely necessary that a regular system should be adopted and strictly adhered to in every part of the business, or much confusion would arise, as is generally the case whenever London surveyors have to meet country practitioners; and it is consequently of the utmost importance to establish the same system throughout the kingdom. The great improvements made in travelling, and the velocity with which we are now conveyed, will soon place every part of this country within a few hours' journey from the metropolis; and the natural consequence of these increased facilities of communication must be, that our habits and methods of doing business will proportionally assimilate.

It is not intended, in this part of the work, to explain the methods of manufacturing any materials,

as bricks, tiles, &c., or the methods of performing the respective works, except so far as to enable the young student to describe the work which he is about to measure, and to ascertain if it be executed in a proper and workmanlike manner. But a perfect knowledge of this department can only be obtained by great attention, perseverance, and practice. The method is shown of valuing all the leading articles in each trade, by first ascertaining the fair price to be allowed for the materials, according to the prime cost thereof, and by adopting what the author considers the ne plus ultra; viz., a decimal, by which, if correctly ascertained, the amount of labour thereon at all periods may be immediately found, by multiplying that decimal by the rate of wages allowed: this is the only method by which perpetual prices can be formed. Materials and labour are continually, but not proportionally, fluctuating; consequently the value of work can only be determined by first ascertaining the cost of the materials expended, and making the requisite allowances for profit and waste, and then the amount of labour in executing it.

As the tradesmen's bills must be passed and signed by the architect, the prime cost of materials may in most instances be obtained without much difficulty, and in all cases may be demanded before he allows the prices charged. The quantities required per rod, perch, square, or yard, according to the description of work, the architect ought, agreeably to certain rules, to be capable of determining. But many difficulties arise, and the greatest attention is

requisite to ascertain correctly the fair average of time to be allowed between the common and best workmen, and also between what men can, and what they will, do. The decimal must therefore be calculated agreeably to our respective judgments, and from the best information we can obtain ; the correctness of which depends on the attention we have paid to the subject, and the opportunities we have had of arriving at our conclusions. Those which are now submitted to the public will be found as correct as they can be made in the compilation of a work like the present. It is anticipated that the professional man may, in his advice to the student, be induced to place this subject properly before him, and establish rules by which every description of work may be valued, according to the prime cost of materials and the rate of wages, at any time and place when and where the work has been performed.

ON MEASURING.

In order to illustrate the principle of measuring the different artificers' works, drawings of reference are given, as the only means of conveying to the architectural student, who has never attended to the admeasurement of work, the correct method of proceeding. The description of book generally used for measuring is shown, with lines ruled according to the old practice: few modern surveyors, however, think of ruling the columns for the dimensions, any more than they would rule lines to write by, it not

being more requisite to those who are in the constant practice of measuring work; but it is always customary to insert the date and the name of the person met, and also for whom, and where the work is done, in the manner hereafter described.

In entering dimensions in the measuring-book, observe that the number of times is always stated on the left of the dimensions; and in measuring brick-work, the number of bricks in thickness on the right side; leaving another space or column for the amount the dimensions square to. Also be particular in entering the wastes in the book; that is, the manner in which the length and width of each dimension is made out; which is frequently done by collecting several together; and likewise the particular situation of the work; so that the student may be able to account for or make out how every dimension was taken, should any misunderstanding arise at a distant period, and he be called upon to give the necessary explanation respecting the way in which he has taken the work: he will then be as ready and quick as it is necessary to be correct.

ABBREVIATION.

Every method that can be adopted to expedite the taking of dimensions with accuracy is most desirable. It is recommended to the young student to attend to the following practice; viz., using a kind of shorthand or abbreviation in describing the different works, which greatly facilitates the operation, and gives time for more attentively observing the measur-

ing rods, to know from ocular demonstration that the dimensions are taken and called correctly; which all who have had much practice in measuring find to be very essential in correcting inaccuracies, from whatever cause they may occur. Although it may appear that this method of adopting initials is not sufficiently explanatory, they will, with a very little practice, be read and understood with as much ease and certainty as if the words were written at full length. In this, as in the other departments, details are given to each respective trade.

ROTATION.

No profession can be successfully pursued without adopting a regular system; and in no department is this more essential than in measuring the multifarious works in a building, which can only be accomplished with any degree of accuracy by invariably taking the respective works in regular succession, by which it is scarcely possible to omit any part of the work, which would constantly occur if some positive and undeviating rule were not attended to. In the following pages, the regular rotation to be adopted in measuring each particular description of work is given under the heads of the respective trades.

ON ABSTRACTING,

AND BRINGING THE QUANTITIES INTO BILL.

The form of the abstract is drawn out for each trade, and also the rotation that should be observed

in placing the particular kinds of work, which, if constantly attended to, will greatly facilitate the operation, as it is always known in what part of the abstract any description of work will be found: this more particularly alludes to the abstract for carpenters' and joiners' work, where there are so many different heads as to make it absolutely necessary to pay the greatest attention to their order and regularity. This and the peculiarities to be attended to in each trade, are more particularly described at the commencement of their respective abstracts. The student is to observe that, before he begins to take out the quantities, he prepares the abstract, by considering what articles he will have, and writes the heads of them in their proper columns, according to the rotation to be observed in bringing them into bill. On this subject examples are given in each trade; but the general rule to be attended to in such trades, where some of the work is valued by the rod, perch, yard, or square, is to place these first, and next the work valued by the cube foot, commencing with the quantities on which there is the least labour, and so in regular rotation to those that have the most. Next proceed with the articles that are valued by the superficial foot, commencing with the lowest, and, as before stated, to those of most value; having entered all those by the foot superficial, then take those by the foot run in a similar manner, and next those that are numbered, as is more particularly described after their respective abstracts.

VALUATION.

In entering on this department, it is imperative to impress on the mind of the young student the absolute necessity of being circumspect and correct. If he intends to maintain his independence and be respected, he must make a point of conscientiously doing his duty with strict integrity; to accomplish which it is not only essential that he be honest in his intentions, but that he should be qualified for the business he undertakes. Whether an act of injustice arises from ignorance or intention, it is precisely the same in effect; it therefore behoves him on every account to be qualified for acting on his own judgment. But he cannot consider himself competent to measure and value artificers' work unless he understands the nature of that work, the manner in which it is executed, the time required to perform the same, and can ascertain the prime cost of the materials used thereon at the period when the work was done. It is only possible to state the time and materials that should be expended in the several works taken on an average, but which will vary according to the description and execution thereof, both as regards the materials used and the ability of the workmen employed. It is the duty of the architect to take all these circumstances into consideration before he affixes a value on the work; consequently, in this department, the greatest care, attention, and judgment are requisite, to do justice to all parties. To give the student the necessary impetus for ac-

quiring these essential qualifications, was the author's principal motive in offering this work to the aspirant.

CONSTANTS OF LABOUR.

These constants represent the time requisite to perform a given quantity of work, of the kind specified, in days and decimal parts of a day; the factor to be applied, being the rate of wages per diem for one or more men, according to the nature of the work.

These decimals are calculated, in all the trades, for the price per day allowed the master in his day bills, consequently with his profit thereon, being the only rate that can be ascertained, the master of course paying each man per week according to his abilities and industry; therefore the full value of the labour, including the master's profit, will be found by multiplying the decimal by the rate of wages, as shown in their respective tables. Likewise, in all cases it must be understood that the prices stated in the table for labour and nails include fixing; and when added to the price of deals, calculated as shown in p. 209, will give the value of the work fixed complete, including labour, nails, and materials, according to the prime cost of materials and rate of wages allowed.

CHAPTER I.

MENSURATION, ETC.

THE arithmetical calculations required to be made in reducing the measurements of artificers' work, and usually called SQUARING DIMENSIONS, are mostly performed by means of *duodecimals*, or fractions in which the denominator (understood but not expressed) is always a power of 12. Thus, the area of a surface whose lineal dimensions are 5 ft. 7 in. by 2 ft. 5 in. is found by multiplying these dimensions together and expressing the result in square feet, 12ths of square feet, and 144ths of square feet, as shown below.

	5	7		
	2	5		
5′7″ × 2′ =	11	2		
5′7″ × 5″ =	2	3	11	
By addition, 5′7″ × 2′5″ =	13	5	11	= 13 sq. ft., 5-12ths of a sq. ft., and 11-144ths of a sq. ft.

The object of Table IV. is to save the greater part of the above calculation, which can be performed by

addition only in the following manner:—At page 92 we have 5 ft. × 24 in. = 10 ft.; 7 in. × 24 in. = 1 ft. 2 in.; at page 73 we have 5 ft. × 5 in. = 2 ft. 1 in.; and 7 in. × 5 in. = 0 ft. 2 in. 11 pa. Therefore, by addition, we obtain the same result as before; thus

10		
1	2	
2	1	
	2	11
13	5	11

Tables are also formed by which such results as the above are obtained by simple reference without any calculation at all (see Hawkings' 'Tables of Superficial Measurement' *), the length and breadth being expressed in inches and the superficial area in square feet, twelfths of square feet, and one hundred and forty-fourths of square feet. Thus we find opposite length 67 in. and breadth 29 in., the area 13.5.11, as obtained above.

Some materials, as timber, stone, &c., being valued according to their *cubical contents*, we have first to multiply together any two of the lineal dimensions as before described, obtaining a result expressed in square feet, 12ths, and 144ths. This result has then to be multiplied by the third dimension, and the cubical contents are found in cubic feet, 12ths of cubic feet, and 144ths of cubic feet. As an example, we will find the cubical contents of a piece

* Lockwood & Co., London.

of timber 11 ft. 9 in. by 1 ft. 2½ in. by 1 ft. 4 in. :—

	11	9	
	1	2	6
11′9″ × 1′ =	11	9	
11′9″ × 2″ =	1	11	6
11′9″ × ½″ =		5	11
By addition, 11′9″ × 1′2½″ =	14	2	5
		1	4
14′2″5 × 1′ =	14	2	5
14′2″5 × 4″ =	4	8	10
By addition, 14′2″5 × 1′4″ =	18	11	3 = 18 cub. ft., 11-12ths of a cub. ft., 3-144ths of a cub. ft.

The same result may be obtained approximately by means of Tables I. and II. Thus, in Table I. (page 37) we find that a piece of timber 14½ in. × 16 in. is equivalent to a piece 15¼ in. square; and by Table II. (page 54) we find 11 ft. length of 15¼ in. square contains 17.9.2 cub. ft.; and three-quarters of a foot of 15¼ square contains 1.2.6 cub. ft., giving a total of 18.11.8 cub. ft. This is rather more than the result obtained by calculation, which difference arises from the square of 15¼ in. being only an *approximation* to the product of 14½ × 16. A more accurate result may be obtained by using Table IV. (page 82), only substituting *inches* long for *feet* long in the vertical column, and inches, or rather 12ths of square feet, in the tabulated result. Thus 16 × 14½ gives 19.4, or 1.7.4, which has only to be multiplied by the length 11 ft. 9 in. and we obtain the cubical contents required.

Fractions which have 10, or a power of 10, for their denominator (understood but not expressed), are called DECIMALS, and are commonly employed for purposes of calculation, as alluded to at page 11 for finding the value of artificers' work according to the price of labour. In decimals the fraction is indicated by a point before the figure: thus ·4 signifies 4-10ths; ·24 signifies 2-10ths and 4-100ths; ·358 signifies 3-10ths, 5-100ths, and 8-1000ths, and so on; if there are no 10ths but only 100ths and 1000ths, a cypher is put after the decimal point, thus ·058; if there are no 100ths, then two cyphers, thus ·008, and so on. Multiplication of decimals is performed in the same way as for any other figures: thus to multiply ·358 by 7, we proceed as in common multiplication and obtain the number 2506; then put as many figures to the right of the decimal point as in the number multiplied, giving as the result 2·506, that is 2-units, 5-10ths, 0-100ths, 6-1000ths.

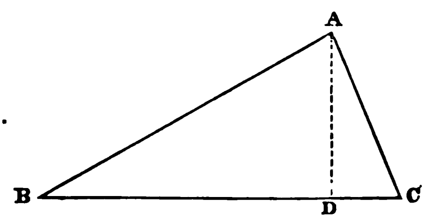
We will apply the decimals to the calculation of the labour in making and hanging a 2 in. four-panel square door, 6 ft. 6 in. by 3 ft. or 19½ sq. ft. in area. We find at page 214 the constant for a two-panel door is ·070 for every square foot, to which is to be added for the two additional panels the fraction ·021, making the number to be ·091; which means that the time allowable for making each superficial foot of the door is 9-100ths of a day and 1-1000th of a day; if we multiply ·091 by 19½ we obtain the number 1·775, by which we find that the making of the door takes 1 whole day, 7-10ths of a day, 7-100ths of a day, and 5-1000ths

of a day. Now, suppose a joiner's wages to be 7 shillings per day, then the value of the labour on the door is found by multiplying 1·775 by 7, which gives 12·425 shillings, or 12 shillings, 4-10ths of a shilling, 2-100ths of a shilling, and 5-1000ths of a shilling, or 12*s.* 5*d.*

In measuring artificers' work it is often necessary to find the area, perimeter, or solidity of certain geometrical figures; it is therefore proposed to give a few of the rules by which such measurements can be most readily made.

To find the area of a TRIANGLE:

FIG. 1.



Let A B C be the triangle (fig. 1). Drop the perpendicular A D upon the base B C. Multiply the length B C in feet by half the height A D in feet, and the product is the area of the triangle in square feet. If the lengths are in yards, the area will be in square yards. This rule is expressed as follows:

$$\text{Area of triangle} = \tfrac{1}{2}\,AD \times BC.$$

To find the area of a triangle when the lengths of the three sides are given:

Let s be the half sum of the three sides; deduct from s the length of each side in succession; multiply together all the three quantities thus formed, and

their product by the value of s; extract the square root of this last product, and the area of the triangle is found. This rule is expressed thus: let a, b, c be the lengths of the three sides, then $s=\frac{a+b+c}{2}$; form the quantities $s-a$, $s-b$, $s-c$; then we have

$$\text{Area of triangle} = \sqrt{\{s\,(s-a)\,(s-b)\,(s-c)\}}$$

Example.—To find the area of a triangle whose sides are 12 ft., 15 ft., and 19 ft. Here, $s=\frac{1}{2}(12+15+19)=23$; $s-a=23-12=11$; $s-b=23-15=8$; $s-c=23-19=4$;

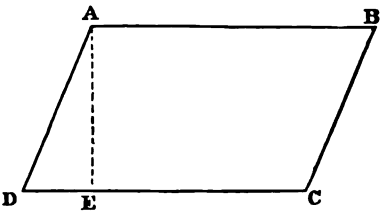
$$\text{Area of triangle} = \sqrt{23\times 11\times 8\times 4} = 4\sqrt{506}.$$
$$=90 \text{ square feet.}$$

The area of a SQUARE is found by *squaring* the length of a side; that is, multiplying the length of a side by itself. If the side is measured in feet, the area will be in square feet. The length of the *diagonal*, or line joining two opposite corners of a square, is found by multiplying the length of a side by the square root of 2, which is 1·414 if expressed in decimals, or 1.5.0 in duodecimals.

The area of an OBLONG, or four-sided figure having opposite sides equal and all its angles right angles, is found by multiplying the length by the breadth. If the lengths are measured in feet, the area will be in square feet. The length of the diagonal of an oblong is found by adding together the squares of two adjacent sides, and extracting the square root of the sum: that is, if l is the length, b the breadth, then diagonal of oblong $=\sqrt{b^2+l^2}$.

The area of any PARALLELOGRAM (fig. 2) A B C D, or four-sided figure having opposite sides equal and

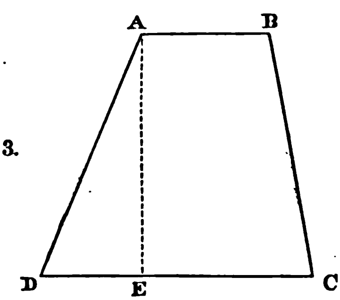
FIG. 2.



parallel, is found by dropping the perpendicular A E on the base D C; and the area is the product of the length D C into the height A E.

The area of a four-sided figure, or TRAPEZIUM, having only one pair of sides parallel, A B and D C

FIG. 3.



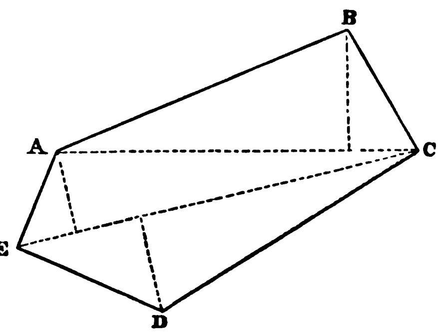
(fig. 3), is found by adding together the lengths A B and D C of the parallel sides, and multiplying their half-sum by the vertical distance A E between them. That is,

$$\text{Area of trapezium} = \frac{\text{A B} + \text{D C}}{2} \times \text{A E}.$$

Example.—Let the top and bottom of a trapezium be 5 ft. and 7 ft., the vertical distance between them being 12 ft. Then the area is $\frac{5+7}{2} \times 12$, or 72 sq. ft.

To find the area of any irregular figure or POLYGON bounded by straight lines, as A B C D E (fig. 4), divide

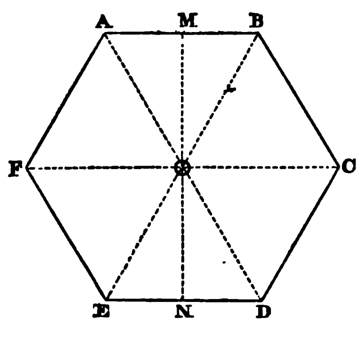
FIG. 4.



it into triangles by the dotted lines A C, C E, then drop perpendiculars from the opposite vertices upon these lines, and find the areas of the triangles by the rule above given. The area of the whole figure is evidently the sum of the areas of the several triangles into which it is divided.

To find the area of any regular POLYGON, or many-sided figure having all its sides and angles equal, as

FIG. 5.



A B C D E F (fig. 5); let O be the centre of the figure, draw the diagonals A O D, B O E, C O F, so as to divide

the figure into as many equal triangles as there are sides; then the area of the polygon is the sum of the areas of these triangles. The point O, where the diagonals all intersect, being equidistant from all the sides of the figure, is the centre of the inscribed circle, or circle which touches all the sides; and if M O N is drawn perpendicular to the opposite sides A B and D E, it is the diameter, and M O or N O the radius of the inscribed circle. The area of one of the triangles, as A O B, is A B multiplied by half M O, or the length of a side multiplied by half the radius of the inscribed circle; therefore the area of the figure is found by multiplying the length of a side by the radius of the inscribed circle, and the product by *half* the number of sides in the polygon.

In the HEXAGON or figure of *six* equal sides, the length of a side is found by multiplying the diameter of the inscribed circle, M N, by the number ·577. And the area is the square of the radius or half-diameter, O N, multiplied by 3·462.

Example.—Let the diameter of the inscribed circle be 10 ft.; then the length of a side is $\cdot577 \times 10$, or 5·77 ft., and the perimeter is $6 \times 5\cdot77$ or 34·62 ft. The area is $5^2 \times 3\cdot462$, or 86·55 sq. ft.

In the OCTAGON, having *eight* equal sides, the length of a side is found by multiplying the diameter of the inscribed circle by the number ·414. And the area is the product of the square of the half-diameter into the number 3·314.

Example.—Let the diameter be 10 ft.; then the length of a side is $\cdot414 \times 10$, or 4·14 ft., and the peri-

meter is $8 \times 4{\cdot}14$, or 33·12 ft. The area is $5^2 \times 3{\cdot}314$, or 82·85 sq. ft.

In the DECAGON, or *ten*-sided figure, the length of a side is the diameter multiplied by ·3249. The area is the square of the half-diameter multiplied by the number 3·249.

Example.—Let the diameter be 10 ft.; then the length of a side is 3·249 ft., and the perimeter is 32·49 ft. The area is $5^2 \times 3{\cdot}249$, or 81·22 sq. ft.

In the DODECAGON, or polygon of *twelve* equal sides, the length of a side is the diameter multiplied by ·268. The area is the square of the half-diameter multiplied by 3·215.

Example.—Let the diameter be 10 ft.; then the length of a side is 2·68 ft., and the perimeter is 32·16 ft. The area is $5^2 \times 3{\cdot}215$, or 80·38 sq. ft.

To find the circumference of a CIRCLE, whose diameter is given, multiply the diameter by 22, and divide the product by 7. Or, if greater accuracy is required, multiply the diameter by 355, and divide the product by 113. The same result will be also obtained in decimals, if the diameter is multiplied by the number 3·1416.

Example.—The diameter of a circle is 10 ft.; then the circumference is $\frac{22 \times 10}{7}$, or 31·4 ft. More accurately, the circumference is $\frac{355 \times 10}{113}$, or 31·416 ft., which is the same as $10 \times 3{\cdot}1416$.

To find the area of a circle whose diameter is known, multiply the *square* of the half-diameter by

22, and divide the product by 7. If greater accuracy is desired, multiply the square of the half-diameter by 355, and divide the product by 113; or, multiply the square of the half-diameter by 3·1416.

Example.—The diameter of a circle is 10 ft.; then the area is $\frac{22 \times 5^2}{7}$, or 78·6 sq. ft. More accurately, the area is $\frac{355 \times 5^2}{113}$, or 78·54 sq. ft.

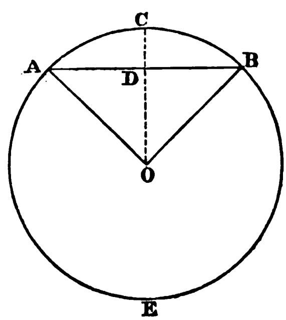
Table V. (page 93) has been formed to facilitate the calculations of areas and circumferences of circles, and to find the squares of numbers. If the *square* of any number in the first column is required, it is found in the second column. The third and fourth columns give the areas of circles corresponding to the diameters given in the first column, expressed in decimals and in duodecimals. The fifth and sixth columns give the corresponding circumferences of circles to the diameters in the first column, both in decimals and duodecimals. The area and circumference of circles of greater diameter than the Table extends to, may be readily found by remembering that areas of circles increase as the *square* of the diameter, and circumferences increase *as* the diameter; that is, if circle B has its diameter double that of circle A, the circumference of B is double that of A, and the area of B is four times that of A; and so on.

Example.—To find by the Table the area and circumference of a circle whose diameter is 15 ft. Referring to the number $7\frac{1}{2}$ (the half of 15) in the first column, we find the area 44·1786, and the cir-

cumference 23·5619; multiply the former number by 4, and we have the area of the circle of 15 ft. diameter, namely, 176·7144 sq. ft. Multiply 23·5619 by 2, and we have the circumference of a circle 15 ft. diameter, namely, 47·1232 ft.

Let A C B E (fig. 6) be a circle having its centre at O. Any line, as A B, drawn across it is called a

FIG. 6.



chord, and the part A C B is called an *arc*. If the straight lines A O and B O are drawn, the figure A C B O is called a *sector*, and the figure A C B between the chord and arc is called a *segment*. If we take D the middle of the chord A B, and draw O D C, D C is the height or *versed-sine* of the arc. The angle A O B is called the angle *subtended* by the arc A C B, and is always proportional thereto; that is, if the arc A B is twice the arc A C, then the angle A O B is double the angle A O C. The area of the *sector* A C B O is to the area of the whole circle in the proportion of the angle A O B to four right angles, or 360°; so that if the angle A O B is known, then the area of the sector is found by multiplying the whole area of the circle by the value of the angle A O B, and dividing the product

by 360. For example: let the angle A O B be 50°, and the radius of the circle 5 ft.; then the area of the circle is $5^2 \times 3{\cdot}1416$, or 78·54 sq. ft., which, multiplied by 50 and divided by 360, gives 10·9 as the number of square feet in the sector. The length of the arc A C B is to that of the whole circumference in the same proportion as the angle A O B to 360; and in this example the circumference being 31·416 ft., the length of the arc A C B is 31·416 multiplied by 50 and divided by 360, or 4·363 ft.

The area of the *segment* A C B is found by deducting the area of the triangle A Q B from the area of the sector A C B O, as found above. Now the area of the triangle A O B is one-half the product of A B into O D. In the above example, where the angle A O B is 50°, and the radius A O is 5 ft., the length of the chord A B is 4·226 ft., and the length of O D is 4·532 ft., hence the area of the triangle A O B is 9·576 sq. ft. The area of the *sector* A C B O being found above to be 10·9 sq. ft., the area of the *segment* A C B is 10·9 less 9·576, or 1·324 sq. ft.

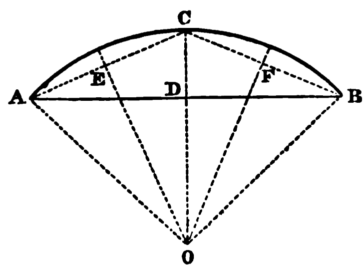
A simple rule is given by Peter Nicholson, by which a tolerably accurate calculation of the area of a segment of a circle can be made without requiring to know the length of the radius of the circle, the *chord* A B and the height, or *versed-sine*, C D only being given. Multiply the length of the chord A B by the height C D, and to two-thirds of the product add the quotient arising from dividing the cube of the height C D by twice the length of the chord A B. This rule is expressed by the following formula:—

$$\text{Area of segment} = \frac{2}{3}\text{AB} \times \text{CD} + \frac{\text{CD}^3}{2\,\text{AB}}.$$

In the above example AB=4·226, CD=·468; hence the area of the segment by this rule is found to be 1·33 sq. ft., which is rather more than that given by the former process; the area, as calculated by Nicholson's rule, being always rather more than the true area, but sufficiently correct for ordinary calculations.

When the chord AB and height CD of a segment are given, the centre of the circle and length of the

FIG. 7.



radius can easily be found geometrically in the following manner. Join AC and BC, and take E and F the middle points of the chords AC and BC respectively; draw EO and FO perpendicular to AC and BC; then the point O in which they meet is the centre of the circle. Produce CD to O, then CO is the radius of the circle.

To find the area of an ELLIPSE of given length and width.

Let AB (fig. 8) be the length or *major-axis*, CD the width or *minor-axis*, and perpendicular to AB; then O is called the *centre* of the ellipse. The area of the whole ellipse is the product of the half-length AO

into the half-width C O, multiplied by 22 and divided by 7. If greater accuracy is required, then multiply

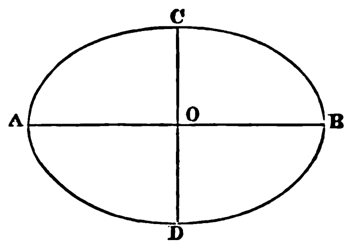


FIG. 8.

the above product by 355, and divide by 113; or multiply the product by the number 3·1416. Since the *axes* divide the ellipse into four equal parts, the area of one of those parts, as A O C, is one-fourth the area of the whole ellipse.

Example.—Let the length A B be 10 ft., the width C D 6 ft.; then the area of the whole ellipse is $\frac{3 \times 5 \times 22}{7}$, or 47·14 sq. ft.; or, more exactly, 47·124 sq. ft.

The length of a curved line can never be *exactly* measured, but we may approximate to it as nearly as we please by taking a number of points on the curve and joining them by a succession of *chords*, or straight lines subtending portions of the curve. If we measure the length of these chords, we get an approximation to the length of the curve; and the smaller the chords and greater their number the more nearly shall we be to the curve. A similar process enables us to find the area of any figure bounded on one or more sides by a curved line, by drawing parallel lines from the ends of all the chords, and measuring the area contained between them and the chords,

which will be nearer and nearer to the required area the greater the number of the chords.

A solid having six oblongs or parallelograms for its faces is called a PARALLELOPIPED when each pair of opposite faces are parallel; and if all the angles are right-angles it is called a RIGHT-SOLID. The *solidity*, *volume*, or cubical content of a *right-solid* is found by multiplying together its three dimensions of length, breadth, and depth.

The solidity of a CYLINDER or PRISM having the top and bottom horizontal and the sides vertical, is found by multiplying the area of the base by the height. The solidity of a CONE is one-third the solidity of a cylinder having the same base and same vertical height.

If the upper part of a *cone* is cut off by a plane parallel to its base, the lower part is called a FRUSTUM of the cone. To find the solidity of a frustum of a cone or pyramid whose axis is vertical and its base a circle or any regular polygon: multiply the area of the base by its half-diameter; also multiply the area of the top by half its diameter, and subtract the latter product from the former; multiply the difference thus found by one-third of the vertical height, and divide by the difference between the two half-diameters. This rule is expressed in the following formula:—

$$\text{solidity of frustum of a cone} = \frac{1}{3}\,\frac{h}{\mathrm{R}-r}(\mathrm{A\,R}-a\,r);$$

where A is the area of the base, a that of the top; R the radius or half-diameter of the base, r that of the top; h the vertical height.

Example.—Let the frustum of a cone have for its base a circle whose radius is 5 ft., and for its top a circle whose radius is $2\frac{1}{2}$ ft.; the vertical height being 12 ft. In this case $A=78{\cdot}54$, $a=19{\cdot}63$, $R-r=2\frac{1}{2}$, $\frac{1}{3}h=4$; hence the solidity is $\frac{8}{5}$ ($78{\cdot}54\times5-19{\cdot}63\times 2{\cdot}5$), or 549·76 cub. ft.

To find the solidity of a *hollow* cylinder, first calculate its volume as if it were solid throughout; then calculate the volume of a cylinder having for its diameter the internal diameter of the cylinder; deduct the latter quantity from the former, and the solidity of the cylinder is found.

The calculation of the solidity of hollow or solid cylinders can be easily found by means of Table V. (p. 93), in which the numbers in the third and fourth columns represent the solid content of cylinders 1 foot in height, of the diameters (also in feet) stated in the first column; and for any other length we have only to multiply that number by the given length to obtain the solid content required.

Example.—To find the solid content of a hollow cylinder whose external diameter is $7\frac{1}{4}$ in., and the internal diameter $5\frac{3}{4}$ in., the height being 7 ft. 6 in.

Referring to the Table, we find against $7\frac{1}{4}$ the number in the third column is 41·2825; and against $5\frac{3}{4}$ the number is 25·9672; subtracting the latter number from the former gives 15·3153, which multiplied by 90 (the length in inches) gives 1378·377 cubic inches as the solidity of the cylinder, and this divided by 1728 gives the solidity in cubic feet.

The area of the vertical surface of a cylinder or

prism is found by multiplying the circumference of the base by the vertical height. For example, the external circumference of the above cylinder is found in Table V. to be 22·7765, which multiplied by 90 gives 204·9885 square inches for the surface, and this divided by 144, gives the area in square feet.

The sloping or curved surface of a cone is found by multiplying the circumference of the base by half the length measured up the slant: the curved surface of the frustum of a cone is found by adding together the perimeters or circumferences at top and bottom, and multiplying their sum by half the distance between them measured up the slant.

The surface of a SPHERE is equal to four times that of a circle of equal diameter, and is found by multiplying the square of the diameter by the number 3·1416.

The solidity, or volume of a sphere is found by multiplying the cube of the diameter, or the length of the diameter multiplied by itself twice over, by the number ·5236.

VALUES
OF
ENGLISH MEASURES AND QUANTITIES,
RELATING TO BUILDING AND LAND.

A Lineal Inch, or inch *run*, is one-twelfth of a lineal foot, and one thirty-sixth of a lineal yard.

A Palm, is 3 lineal inches.

A Hand, is 4 lineal inches.

A Span, is 9 lineal inches, or a quarter of a yard, or half a cubit.

A Lineal Foot, or foot *run*, is 12 lineal inches, or 3 hands.

A Square Inch, is a square having each side measuring one lineal inch.

A Square Foot, or foot *superficial*, is a square having each side measuring one lineal foot, or 12 lineal inches, and contains 144 square inches.

A Cubical Inch, is a cube having each face one square inch.

A Cubical Foot, is a cube having each face one square foot, and contains 1728 cubical inches.

A Cubit, is 4 hands and a half, or 1 foot and a half lineal.

A Lineal Yard, or yard *run*, is 3 lineal feet, or 36 lineal inches, or 2 cubits.

A Square Yard, or yard *superficial*, is a square

having each side measuring one lineal yard, and contains 9 square feet.

A Cubical Yard, is a cube having each face one square yard, and contains 27 cubical feet.

An Ell is 1 lineal yard and a quarter, or 45 lineal inches.

A Geometrical Pace, is 5 lineal feet.

A Fathom, is 6 lineal feet, or 2 lineal yards.

A Square, is 100 square or superficial feet.

A Statute Pole, or *perch*, or *rod*, is 16 lineal feet and a half, or $5\frac{1}{2}$ lineal yards.

A Chain, is 4 statute poles, or perches, or 22 lineal yards.

A Fen, or *woodland pole*, or *perch*, is 18 lineal feet.

A Forest Pole, or *perch*, is 21 lineal feet or 7 lineal yards.

A Furlong, is 40 statute poles, or perches, or 10 chains, or 220 lineal yards.

A Mile, is 8 furlongs, or 80 chains, or 1760 lineal yards.

A Square Statute Pole, or *perch*, is $30\frac{1}{4}$ sq. yds. or $272\frac{1}{4}$ sq. ft.

A Square Woodland Pole, or *perch*, is 324 sq. ft.

A Rood, is 40 square statute poles, or perches, or 1210 sq. yds.

An Acre, is 4 roods, or 160 perches, or 4840 sq. yds.

A Load of rough timber, is 40 cubical ft.

A Load of squared timber, is 50 cubical ft.

A Load of 1-inch plank, is 600 sq. ft.

A Load of $1\frac{1}{2}$-inch plank, is 400 sq. ft.

A LOAD of 2-inch plank, is 300 sq. ft.

A LOAD of 2½-inch plank, is 240 sq. ft.

A LOAD of 3-inch plank, is 200 sq. ft.

A LOAD of 3½-inch plank, is 170 sq. ft.

A LOAD of 4-inch plank, is 150 sq. ft.

A LOAD of statute bricks, is 500.

A LOAD of plain tiles, is 1000.

A LOAD of lime, is 32 bushels.

A LOAD of sand, is 36 bushels.

A HUNDRED of lime, is 35 bushels.

A BUSHEL, is 2218 cubical inches.

A HUNDRED of deals, is 120.

A HUNDRED of nails, is 120.

A THOUSAND of nails, is 1200.

A THOUSAND of slates, is 1200.

A TON of iron, is 2240 pounds weight.

A FODDER of lead, is 19½ hundred, or 2184 pounds.

A HUNDRED of lead, is 112 pounds weight.

A TABLE of glass, is 5 ft., and 45 tables is a case; but of Newcastle and Normandy glass, 25 tables make a case.

A BUNDLE of 4 feet oak-heart laths, is 120, and 37½ bundles are a load.

A BUNDLE of 5 ft. oak-heart laths, is 100, and 30 bundles are a load.

N.B.—FIR or DEAL LATHS are of divers lengths, as 3, 4, 5, and 6 ft.; but all of them are reduced to the standard length of 5 ft.; and so every 150 ft. run of bundles (each bundle containing 100 laths) is a load, being equal to 30 bundles of 5 ft. laths.

HOPPUS'S TABLES.

TABLE I.

SQUARE OF UNEQUAL-SIDED TIMBER, ETC.

By this Table the side of a square piece equivalent to any piece of timber, stone, &c., broader one way than the other, may be found, from 2 inches to 18 inches, the broadest side; and therefore, by addition only, may serve to any greater breadth, if there should ever be occasion.

The figures at the left hand of the top of each Table are the thickness or lesser side, and the figures in the first column are the breadth or larger side, of the end of a piece of timber of which the square is required. The second column of figures shows the side of a square piece, in inches and quarters of an inch, answering to the contents of the unequal-sided piece.

Example I.—To find the side of the square equivalent to a piece of timber or stone, whose scantling or size is 3 inches thick and 7 inches broad. Look in the column of scantling for 3 inches, the thickness

(or lesser side), keeping the eye down the column till you come to 7 inches the breadth (or greater side), and over against that will be found $4\frac{1}{2}$ inches, and that is the side (nearly) of the square of a piece equal to one 3 inches thick, and 7 inches broad.

Example II.—To find the square side of a piece of stone too large for the extent of this Table, say, 28 inches by 34 inches. Take half the thickness of 28, which is 14, and half the breadth of 34, which is 17; look in the Table for 14 by 17, and over against that is $15\frac{1}{2}$, which $15\frac{1}{2}$ is one-half of the square side of the piece; and that doubled makes 31, which is the side of the square piece required.

In.		*In.*	*Sqr.*
2	by	2½	2¼
		3	2½
		3½	2¾
		4	2¾
		4½	3
		5	3¼
		5½	3½
		6	3½
		6½	3¾
		7	3¾
		7½	3¾
		8	4
		8½	4
		9	4¼
		9½	4¼
		10	4½
		10½	4½
		11	4¾
		11½	4¾
		12	5
		12½	5
		13	5¼
		13½	5¼
		14	5¼
		14½	5½
		15	5½
		15½	5½
		16	5¾
		16½	5¾
		17	5¾
		17½	6
		18	6
2½	by	3	2¾
		3½	3
		4	3¼
		4½	3½
		5	3½
		5½	3¾
		6	3¾
		6½	4
		7	4¼
		7½	4¼
		8	4½
		8½	4½
		9	4¾
		9½	4¾
		10	5
		10½	5
		11	5¼
		11½	5¼
		12	5½
		12½	5½
2½	by	13	5¾
		13½	5¾
		14	6
		14½	6
		15	6¼
		15½	6¼
		16	6¼
		16½	6½
		17	6½
		17½	6½
		18	6¾
3	by	3½	3¼
		4	3½
		4½	3¾
		5	3¾
		5½	4
		6	4¼
		6½	4¼
		7	4½
		7½	4¾
		8	4¾
		8½	5
		9	5¼
		9½	5¼
		10	5½
		10½	5½
		11	5¾
		11½	6
		12	6
		12½	6¼
		13	6¼
		13½	6¼
		14	6½
		14½	6½
		15	6¾
		15½	6¾
		16	7
		16½	7
		17	7¼
		17½	7¼
		18	7½
3½	by	4	3¾
		4½	3¾
		5	4
		5½	4¼
		6	4½
		6½	4¾
		7	5
		7½	5
		8	5¼
		8½	5½
3½	by	9	5½
		9½	5¾
		10	6
		10½	6
		11	6¼
		11½	6¼
		12	6½
		12½	6½
		13	6¾
		13½	7
		14	7
		14½	7
		15	7¼
		15½	7¼
		16	7½
		16½	7½
		17	7¾
		17½	7¾
		18	8
4	by	4½	4¼
		5	4½
		5½	4¾
		6	5
		6½	5
		7	5¼
		7½	5½
		8	5½
		8½	5¾
		9	6
		9½	6¼
		10	6¼
		10½	6½
		11	6½
		11½	6¾
		12	7
		12½	7
		13	7¼
		13½	7¼
		14	7½
		14½	7½
		15	7¾
		15½	7¾
		16	8
		16½	8¼
		17	8¼
		17½	8½
		18	8½
4½	by	5	4¾
		5½	5
		6	5¼
		6½	5½
4½	by	7	5½
		7½	5¾
		8	6
		8½	6¼
		9	6¼
		9½	6½
		10	6¾
		10½	6¾
		11	7
		11½	7¼
		12	7¼
		12½	7½
		13	7¾
		13½	7¾
		14	8
		14½	8
		15	8¼
		15½	8¼
		16	8½
		16½	8½
		17	8¾
		17½	8¾
		18	9
5	by	5½	5¼
		6	5½
		6½	5¾
		7	6
		7½	6
		8	6¼
		8½	6½
		9	6¾
		9½	6¾
		10	7
		10½	7¼
		11	7½
		11½	7½
		12	7¾
		12½	8
		13	8
		13½	8¼
		14	8¼
		14½	8½
		15	8¾
		15½	8¾
		16	9
		16½	9¼
		17	9¼
		17½	9½
		18	9½
5½	by	6	5¾
		6½	6

In.		*In.*	*Sqr.*
5½	by	7	6¼
		7½	6½
		8	6¾
		8½	6¾
		9	7
		9½	7¼
		10	7½
		10½	7½
		11	7¾
		11½	8
		12	8
		12½	8¼
		13	8½
		13½	8½
		14	8¾
		14½	9
		15	9
		15½	9¼
		16	9½
		16½	9½
		17	9¾
		17½	9¾
		18	10
6	by	6½	6¼
		7	6½
		7½	6¾
		8	7
		8½	7¼
		9	7¼
		9½	7½
		10	7¾
		10½	8
		11	8
		11½	8¼
		12	8½
		12½	8¾
		13	8¾
		13½	9
		14	9¼
		14½	9¼
		15	9½
		15½	9¾
		16	9¾
		16½	10
		17	10
		17½	10¼
		18	10½
6½	by	7	6¾
		7½	7
		8	7¼
		8½	7½
		9	7¾
		9½	7¾
		10	8
		10½	8¼
		11	8½
		11½	8¾
		12	8¾
		12½	9
		13	9¼
		13½	9¼
		14	9½
		14½	9¾
		15	10
		15½	10
		16	10¼
		16½	10¼
		17	10½
		17½	10¾
		18	11
7	by	7½	7¼
		8	7½
		8½	7¾
		9	8
		9½	8¼
		10	8¼
		10½	8½
		11	8¾
		11½	9
		12	9¼
		12½	9¼
		13	9½
		13½	9¾
		14	10
		14½	10
		15	10¼
		15½	10½
		16	10½
		16½	10¾
		17	11
		17½	11
		18	11¼
7½	by	8	7¾
		8½	8
		9	8¼
		9½	8½
		10	8¾
		10½	8¾
		11	9
		11½	9¼
		12	9½
		12½	9¾
		13	9¾
		13½	10
		14	10¼
		14½	10½
		15	10½
		15½	10¾
		16	11
		16½	11
		17	11¼
		17½	11½
		18	11¾
8	by	8½	8¼
		9	8½
		9½	8¾
		10	9
		10½	9¼
		11	9½
		11½	9½
		12	9¾
		12½	10
		13	10¼
		13½	10½
		14	10½
		14½	10¾
		15	11
		15½	11¼
		16	11¼
		16½	11½
		17	11¾
		17½	11¾
		18	12
8½	by	9	8¾
		9½	9
		10	9¼
		10½	9½
		11	9¾
		11½	10
		12	10
		12½	10¼
		13	10½
		13½	10¾
		14	11
		14½	11
		15	11¼
		15½	11½
		16	11¾
		16½	11¾
		17	12
		17½	12¼
		18	12¼
9	by	9½	9¼
		10	9½
		10½	9¾
		11	10
		11½	10¼
		12	10½
		12½	10½
		13	10¾
		13½	11
		14	11¼
		14½	11½
		15	11½
		15½	11¾
		16	12
		16½	12¼
		17	12½
		17½	12½
		18	12¾
9½	by	10	9¾
		10½	10
		11	10¼
		11½	10½
		12	10¾
		12½	11
		13	11
		13½	11¼
		14	11½
		14½	11¾
		15	12
		15½	12¼
		16	12¼
		16½	12½
		17	12¾
		17½	13
		18	13
10	by	10½	10¼
		11	10½
		11½	10¾
		12	11
		12½	11¼
		13	11½
		13½	11¾
		14	12
		14½	12¼
		15	12¼
		15½	12½
		16	12¾
		16½	13
		17	13¼
		17½	13½
		18	13½

In.	In.	Sqr.
10½ by	11	10¾
	11½	11
	12	11¼
	12½	11½
	13	11¾
	13½	12
	14	12¼
	14½	12½
	15	12¾
	15½	13
	16	13
	16½	13¼
	17	13½
	17½	13¾
	18	14
11 by	11½	11¼
	12	11½
	12½	11¾
	13	12
	13½	12¼
	14	12½
	14½	12¾
	15	13
	15½	13
	16	13¼
	16½	13½
	17	13¾
	17½	14
	18	14¼
11½ by	12	11¾
	12½	12
	13	12¼
11½ by	13½	12¼
	14	12½
	14½	12¾
	15	13
	15½	13¼
	16	13½
	16½	13¾
	17	14
	17½	14¼
	18	14½
12 by	12½	12¼
	13	12½
	13½	12¾
	14	13
	14½	13¼
	15	13½
	15½	13¾
	16	13¾
	16½	14
	17	14¼
	17½	14½
	18	14¾
12½ by	13	12¾
	13½	13
	14	13¼
	14½	13½
	15	13¾
	15½	14
	16	14¼
	16½	14¼
	17	14½
12½ by	17½	14¾
	18	15
13 by	13½	13¼
	14	13½
	14½	13¾
	15	14
	15½	14¼
	16	14½
	16½	14¾
	17	14¾
	17½	15
	18	15¼
13½ by	14	13¾
	14½	14
	15	14¼
	15½	14½
	16	14¾
	16½	15
	17	15¼
	17½	15¼
	18	15½
14 by	14½	14¼
	15	14½
	15½	14¾
	16	15
	16½	15¼
	17	15½
	17½	15¾
	18	16
14½ by	15	14¾
	15½	15
	16	15¼
	16½	15½
	17	15¾
	17½	16
	18	16¼
15 by	15½	15¼
	16	15½
	16½	15¾
	17	16
	17½	16¼
	18	16½
15½ by	16	15¾
	16½	16
	17	16¼
	17½	16½
	18	16¾
16 by	16½	16¼
	17	16½
	17½	16¾
	18	17
16½ by	17	16¾
	17½	17
	18	17¼
17 by	17½	17¼
	18	17½
17½ by	18	17¾

TABLE II.

SOLID OR CUBICAL MEASURE OF TIMBER, ETC.

By this Table the solid content, and consequently the value, of any piece or quantity of timber, stone, &c., may be found, AT SIGHT, from 2 inches to 18 inches, the side of the square (or one-fourth of the girt), and from one-quarter of a foot to 45 feet, the length; and therefore, by addition only, may serve to any greater breadth, if there should ever be occasion.

The Table begins with two inches, the side of the square, and by the addition of a quarter of an inch enlarges itself to the extent of 18 inches, the side of the square. Every page consists of four distinct parts, divided from each other by a thick line; and at the top of each of the said parts is set down the side of the square piece that has been found by Table I. to be equal to the piece intended to be measured.

The first column to the left hand shows the several lengths, in feet, from one quarter of a foot to 45 feet, and of such a square piece of timber, whose side is set down at the top. The three figures in the second column, marked at the top with Ft. In. Pa., give the solid content in cubic feet, 12ths of a cubic foot, and

144ths of a cubic foot, answering to the length in the left-hand column.

To measure square timber or stone, measure the length of the piece in feet, and set it down in the memorandum book. Then, if the timber be equal-sided, take the side of the square in inches, and quarters, and set that down likewise. (If the timber is unequal-sided, first reduce it to a square by Table I.) Look at the top of the Table for the side of the square; and having found that, keep the eye down the left-hand column until the length of the piece is found in feet; and the three rows of figures which stand over against the length in feet, represent the solid content.

Example I.—To find the solid content of a piece 19 feet long, of which the side of the square is 14¾ inches. Having found 14¾, the side of the square, look for 19 feet in the left-hand column, and over against it stands 28 ft. 8 in. 5 pa.

Example II.—To find the solid content of a piece of stone whose side is greater than the largest in the Table, say 26 inches, the length being 37 feet. Take the half of 26, or 13 ; find 13 the side of the square, and over against 37 feet is 43.5.1, which multiply by 4, and the product is the content of the piece 26 inches square and 37 feet long—namely, 173 ft. 5 in. 1 pa.

Example III.—To find the solid content of a piece

14 inches square and 22½ feet long. Seek in the Table for 14 inches, the side of the square, and 22 feet the length, which set down ; then find the ½ foot at the bottom of the Table, and set that down under the former quantity; add these together, and the sum is the content required—namely,

	ft.	in.	pa.
22 ft. long is . . .	29	11	4
½ ft.	0	8	2
The content required	30	7	6

Ft. long	*Side 2 in.* Ft.	In.	Pa.	*Ft. long*	*Side 2¼ in.* Ft.	In.	Pa.	*Ft. long*	*Side 2½ in.* Ft.	In.	Pa.	*Ft. long*	*Side 2¾ in.* Ft.	In.	Pa.
1	0	0	4	1	0	0	5	1	0	0	6	1	0	0	7
2	0	0	8	2	0	0	10	2	0	1	0	2	0	1	3
3	0	1	0	3	0	1	3	3	0	1	6	3	0	1	10
4	0	1	4	4	0	1	8	4	0	2	1	4	0	2	6
5	0	1	8	5	0	2	1	5	0	2	7	5	0	3	1
6	0	2	0	6	0	2	6	6	0	3	1	6	0	3	9
7	0	2	4	7	0	2	11	7	0	3	7	7	0	4	4
8	0	2	8	8	0	3	4	8	0	4	2	8	0	5	0
9	0	3	0	9	0	3	9	9	0	4	8	9	0	5	8
10	0	3	4	10	0	4	2	10	0	5	2	10	0	6	3
11	0	3	8	11	0	4	7	11	0	5	8	11	0	6	11
12	0	4	0	12	0	5	0	12	0	6	3	12	0	7	6
13	0	4	4	13	0	5	5	13	0	6	9	13	0	8	2
14	0	4	8	14	0	5	10	14	0	7	3	14	0	8	9
15	0	5	0	15	0	6	3	15	0	7	9	15	0	9	5
16	0	5	4	16	0	6	8	16	0	8	4	16	0	10	1
17	0	5	8	17	0	7	1	17	0	8	10	17	0	10	8
18	0	6	0	18	0	7	6	18	0	9	4	18	0	11	4
19	0	6	4	19	0	7	11	19	0	9	10	19	0	11	11
20	0	6	8	20	0	8	4	20	0	10	5	20	1	0	7
21	0	7	0	21	0	8	9	21	0	10	11	21	1	1	2
22	0	7	4	22	0	9	2	22	0	11	5	22	1	1	10
23	0	7	8	23	0	9	7	23	0	11	11	23	1	2	5
24	0	8	0	24	0	10	0	24	1	0	6	24	1	3	1
25	0	8	4	25	0	10	5	25	1	1	0	25	1	3	9
26	0	8	8	26	0	10	10	26	1	1	6	26	1	4	4
27	0	9	0	27	0	11	3	27	1	2	0	27	1	5	0
28	0	9	4	28	0	11	8	28	1	2	7	28	1	5	7
29	0	9	8	29	1	0	1	29	1	3	1	29	1	6	3
30	0	10	0	30	1	0	6	30	1	3	7	30	1	6	10
31	0	10	4	31	1	0	11	31	1	4	1	31	1	7	6
32	0	10	8	32	1	1	4	32	1	4	8	32	1	8	2
33	0	11	0	33	1	1	9	33	1	5	2	33	1	8	9
34	0	11	4	34	1	2	2	34	1	5	8	34	1	9	5
35	0	11	8	35	1	2	7	35	1	6	2	35	1	10	0
36	1	0	0	36	1	3	0	36	1	6	9	36	1	10	8
37	1	0	4	37	1	3	5	37	1	7	3	37	1	11	3
38	1	0	8	38	1	3	10	38	1	7	9	38	1	11	10
39	1	1	0	39	1	4	3	39	1	8	3	39	2	0	6
40	1	1	4	40	1	4	8	40	1	8	10	40	2	1	2
41	1	1	8	41	1	5	1	41	1	9	4	41	2	1	10
42	1	2	0	42	1	5	6	42	1	9	10	42	2	2	5
43	1	2	4	43	1	5	11	43	1	10	4	43	2	3	1
44	1	2	8	44	1	6	4	44	1	10	11	44	2	3	8
45	1	3	0	45	1	6	9	45	1	11	5	45	2	4	4

	Quarters of a Foot. Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.
¼	0	0	1	0	¼	0	0	1	3	¼	0	0	1	6	¼	0	0	1	9
½	0	0	2	0	½	0	0	2	6	½	0	0	2	0	½	0	0	3	6
¾	0	0	3	0	¾	0	0	3	9	¾	0	0	3	6	¾	0	0	5	3

Ft. long	Side 3 in. Ft.	In.	Pa.	Ft. long	Side 3¼ in. Ft.	In.	Pa.	Ft. long	Side 3½ in. Ft.	In.	Pa.	Ft. long	Side 3¾ in. Ft.	In.	Pa.
1	0	0	9	1	0	0	10	1	0	1	0	1	0	1	2
2	0	1	6	2	0	1	9	2	0	2	0	2	0	2	4
3	0	2	3	3	0	2	7	3	0	3	0	3	0	3	6
4	0	3	0	4	0	3	6	4	0	4	1	4	0	4	8
5	0	3	9	5	0	4	4	5	0	5	1	5	0	5	10
6	0	4	6	6	0	5	3	6	0	6	1	6	0	7	0
7	0	5	3	7	0	6	1	7	0	7	1	7	0	8	2
8	0	6	0	8	0	7	0	8	0	8	2	8	0	9	4
9	0	6	9	9	0	7	11	9	0	9	2	9	0	10	6
10	0	7	6	10	0	8	9	10	0	10	2	10	0	11	8
11	0	8	3	11	0	9	8	11	0	11	2	11	1	0	10
12	0	9	0	12	0	10	6	12	1	0	3	12	1	2	0
13	0	9	9	13	0	11	5	13	1	1	3	13	1	3	2
14	0	10	6	14	1	0	3	14	1	2	3	14	1	4	4
15	0	11	3	15	1	1	2	15	1	3	3	15	1	5	6
16	1	0	0	16	1	2	1	16	1	4	4	16	1	6	9
17	1	0	9	17	1	2	11	17	1	5	4	17	1	7	11
18	1	1	6	18	1	3	10	18	1	6	4	18	1	9	1
19	1	2	3	19	1	4	8	19	1	7	4	19	1	10	3
20	1	3	0	20	1	5	7	20	1	8	5	20	1	11	5
21	1	3	9	21	1	6	5	21	1	9	5	21	2	0	7
22	1	4	6	22	1	7	4	22	1	10	5	22	2	1	9
23	1	5	3	23	1	8	2	23	1	11	5	23	2	2	11
24	1	6	0	24	1	9	1	24	2	0	6	24	2	4	1
25	1	6	9	25	1	10	0	25	2	1	6	25	2	5	3
26	1	7	6	26	1	10	10	26	2	2	6	26	2	6	5
27	1	8	3	27	1	11	9	27	2	3	6	27	2	7	7
28	1	9	0	28	2	0	7	28	2	4	7	28	2	8	9
29	1	9	9	29	2	1	6	29	2	5	7	29	2	9	11
30	1	10	6	30	2	2	4	30	2	6	7	30	2	11	1
31	1	11	3	31	2	3	3	31	2	7	7	31	3	0	3
32	2	0	0	32	2	4	2	32	2	8	8	32	3	1	6
33	2	0	9	33	2	5	0	33	2	9	8	33	3	2	8
34	2	1	6	34	2	5	11	34	2	10	8	34	3	3	10
35	2	2	3	35	2	6	9	35	2	11	8	35	3	5	0
36	2	3	0	36	2	7	8	36	3	0	9	36	3	6	2
37	2	3	9	37	2	8	6	37	3	1	9	37	3	7	4
38	2	4	6	38	2	9	5	38	3	2	9	38	3	8	6
39	2	5	3	39	2	10	3	39	3	3	9	39	3	9	8
40	2	6	0	40	2	11	2	40	3	4	10	40	3	10	10
41	2	6	9	41	3	0	1	41	3	5	10	41	4	0	0
42	2	7	6	42	3	0	11	42	3	6	10	42	4	1	2
43	2	8	3	43	3	1	10	43	3	7	10	43	4	2	4
44	2	9	0	44	3	2	8	44	3	8	11	44	4	3	6
45	2	9	9	45	3	3	7	45	3	9	11	45	4	4	8

Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	0	2	3	¼	0	0	2	6	¼	0	0	3	0	¼	0	0	3	6
½	0	0	4	6	½	0	0	5	0	½	0	0	6	0	½	0	0	7	0
¾	0	0	6	9	¾	0	0	7	6	¾	0	0	9	0	¾	0	0	10	6

Ft. long	Side 4 in.			Ft. long	Side 4¼ in.			Ft. long	Side 4½ in.			Ft. long	Side 4¾ in.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	1	4	1	0	1	6	1	0	1	8	1	0	1	10
2	0	2	8	2	0	3	0	2	0	3	4	2	0	3	9
3	0	4	0	3	0	4	6	3	0	5	0	3	0	5	7
4	0	5	4	4	0	6	0	4	0	6	9	4	0	7	6
5	0	6	8	5	0	7	6	5	0	8	5	5	0	9	4
6	0	8	0	6	0	9	0	6	0	10	1	6	0	11	3
7	0	9	4	7	0	10	6	7	0	11	9	7	1	1	1
8	0	10	8	8	1	0	0	8	1	1	6	8	1	3	0
9	1	0	0	9	1	1	6	9	1	3	2	9	1	4	11
10	1	1	4	10	1	3	0	10	1	4	10	10	1	6	9
11	1	2	8	11	1	4	6	11	1	6	6	11	1	8	8
12	1	4	0	12	1	6	0	12	1	8	3	12	1	10	6
13	1	5	4	13	1	7	6	13	1	9	11	13	2	0	5
14	1	6	8	14	1	9	0	14	1	11	7	14	2	2	3
15	1	8	0	15	1	10	6	15	2	1	3	15	2	4	2
16	1	9	4	16	2	0	1	16	2	3	0	16	2	6	1
17	1	10	8	17	2	1	7	17	2	4	8	17	2	7	11
18	2	0	0	18	2	3	1	18	2	6	4	18	2	9	10
19	2	1	4	19	2	4	7	19	2	8	0	19	2	11	8
20	2	2	8	20	2	6	1	20	2	9	9	20	3	1	7
21	2	4	0	21	2	7	7	21	2	11	5	21	3	3	5
22	2	5	4	22	2	9	1	22	3	1	1	22	3	5	4
23	2	6	8	23	2	10	7	23	3	2	9	23	3	7	2
24	2	8	0	24	3	0	1	24	3	4	6	24	3	9	1
25	2	9	4	25	3	1	7	25	3	6	2	25	3	11	0
26	2	10	8	26	3	3	1	26	3	7	10	26	4	0	10
27	3	0	0	27	3	4	7	27	3	9	6	27	4	2	9
28	3	1	4	28	3	6	1	28	3	11	3	28	4	4	7
29	3	2	8	29	3	7	7	29	4	0	11	29	4	6	6
30	3	4	0	30	3	9	1	30	4	2	7	30	4	8	4
31	3	5	4	31	3	10	7	31	4	4	3	31	4	10	3
32	3	6	8	32	4	0	2	32	4	6	0	32	5	0	2
33	3	8	0	33	4	1	8	33	4	7	8	33	5	2	0
34	3	9	4	34	4	3	2	34	4	9	4	34	5	3	11
35	3	10	8	35	4	4	8	35	4	11	0	35	5	5	9
36	4	0	0	36	4	6	2	36	5	0	9	36	5	7	8
37	4	1	4	37	4	7	8	37	5	2	5	37	5	9	6
38	4	2	8	38	4	9	2	38	5	4	1	38	5	11	5
39	4	4	0	39	4	10	8	39	5	5	9	39	6	1	3
40	4	5	4	40	5	0	2	40	5	7	6	40	6	3	2
41	4	6	8	41	5	1	8	41	5	9	2	41	6	5	1
42	4	8	0	42	5	3	2	42	5	10	10	42	6	6	11
43	4	9	4	43	5	4	8	43	6	0	6	43	6	8	10
44	4	10	8	44	5	6	2	44	6	2	3	44	6	10	8
45	5	0	0	45	5	7	8	45	6	3	11	45	7	0	7

Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.				
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	0	4	0	¼	0	0	4	6	¼	0	0	5	0	¼	0	0	5	6
½	0	0	8	0	½	0	0	9	0	½	0	0	10	0	½	0	0	11	0
¾	0	1	0	0	¾	0	1	1	6	¾	0	1	3	0	¾	0	1	4	6

Ft. long	Side 5 in.			Ft. long	Side 5¼ in.			Ft. long	Side 5½ in.			Ft. long	Side 5¾ in.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	2	1	1	0	2	3	1	0	2	6	1	0	2	9
2	0	4	2	2	0	4	7	2	0	5	0	2	0	5	6
3	0	6	3	3	0	6	10	3	0	7	6	3	0	8	3
4	0	8	4	4	0	9	2	4	0	10	1	4	0	11	0
5	0	10	5	5	0	11	5	5	1	0	7	5	1	1	9
6	1	0	6	6	1	1	9	6	1	3	1	6	1	4	6
7	1	2	7	7	1	4	0	7	1	5	7	7	1	7	3
8	1	4	8	8	1	6	4	8	1	8	2	8	1	10	0
9	1	6	9	9	1	8	8	9	1	10	8	9	2	0	9
10	1	8	10	10	1	10	11	10	2	1	2	10	2	3	6
11	1	10	11	11	2	1	3	11	2	3	8	11	2	6	3
12	2	1	0	12	2	3	6	12	2	6	3	12	2	9	0
13	2	3	1	13	2	5	10	13	2	8	9	13	2	11	9
14	2	5	2	14	2	8	1	14	2	11	3	14	3	2	6
15	2	7	3	15	2	10	5	15	3	1	9	15	3	5	3
16	2	9	4	16	3	0	9	16	3	4	4	16	3	8	1
17	2	11	5	17	3	3	0	17	3	6	10	17	3	10	10
18	3	1	6	18	3	5	4	18	3	9	4	18	4	1	7
19	3	3	7	19	3	7	7	19	3	11	10	19	4	4	4
20	3	5	8	20	3	9	11	20	4	2	5	20	4	7	1
21	3	7	9	21	4	0	2	21	4	4	11	21	4	9	10
22	3	9	10	22	4	2	6	22	4	7	5	22	5	0	7
23	3	11	11	23	4	4	9	23	4	9	11	23	5	3	4
24	4	2	0	24	4	7	1	24	5	0	6	24	5	6	1
25	4	4	1	25	4	9	5	25	5	3	0	25	5	8	10
26	4	6	2	26	4	11	8	26	5	5	6	26	5	11	7
27	4	8	3	27	5	2	0	27	5	8	0	27	6	2	4
28	4	10	4	28	5	4	3	28	5	10	6	28	6	5	1
29	5	0	5	29	5	6	7	29	6	1	1	29	6	7	10
30	5	2	6	30	5	8	10	30	6	3	7	30	6	10	7
31	5	4	7	31	5	11	2	31	6	6	1	31	7	1	4
32	5	6	8	32	6	1	6	32	6	8	8	32	7	4	2
33	5	8	9	33	6	3	9	33	6	11	2	33	7	6	11
34	5	10	10	34	6	6	1	34	7	1	8	34	7	9	8
35	6	0	11	35	6	8	4	35	7	4	2	35	8	0	5
36	6	3	0	36	6	10	8	36	7	6	9	36	8	3	2
37	6	5	1	37	7	0	11	37	7	9	3	37	8	6	11
38	6	7	2	38	7	3	3	38	7	11	9	38	8	8	8
39	6	9	3	39	7	5	6	39	8	2	3	39	8	11	5
40	6	11	4	40	7	7	10	40	8	4	10	40	9	2	2
41	7	1	5	41	7	10	2	41	8	7	4	41	9	4	11
42	7	3	6	42	8	0	5	42	8	9	10	42	9	7	8
43	7	5	7	43	8	2	9	43	9	0	4	43	9	10	5
44	7	7	8	44	8	5	0	44	9	2	11	44	10	1	2
45	7	9	9	45	8	7	4	45	9	5	5	45	10	3	11

Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.				
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	0	6	3	¼	0	0	6	9	¼	0	0	7	6	¼	0	0	8	3
½	0	1	0	6	½	0	1	1	6	½	0	1	3	0	½	0	1	4	6
¾	0	1	6	9	¾	0	1	8	3	¾	0	1	10	6	¾	0	2	0	9

Ft. long	Side 6 in.			Ft. long	Side 6¼ in.			Ft. long	Side 6½ in.			Ft. long	Side 6¾ in.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	3	0	1	0	3	3	1	0	3	6	1	0	3	9
2	0	6	0	2	0	6	6	2	0	7	0	2	0	7	7
3	0	9	0	3	0	9	9	3	0	10	6	3	0	11	4
4	1	0	0	4	1	1	0	4	1	2	1	4	1	3	2
5	1	3	0	5	1	4	3	5	1	5	7	5	1	6	11
6	1	6	0	6	1	7	6	6	1	9	1	6	1	10	9
7	1	9	0	7	1	10	9	7	2	0	7	7	2	2	6
8	2	0	0	8	2	2	0	8	2	4	2	8	2	6	4
9	2	3	0	9	2	5	3	9	2	7	8	9	2	10	2
10	2	6	0	10	2	8	6	10	2	11	2	10	3	1	11
11	2	9	0	11	2	11	9	11	3	2	8	11	3	5	9
12	3	0	0	12	3	3	0	12	3	6	3	12	3	9	6
13	3	3	0	13	3	6	3	13	3	9	9	13	4	1	4
14	3	6	0	14	3	9	6	14	4	1	3	14	4	5	1
15	3	9	0	15	4	0	9	15	4	4	9	15	4	8	11
16	4	0	0	16	4	4	1	16	4	8	4	16	5	0	9
17	4	3	0	17	4	7	4	17	4	11	10	17	5	4	6
18	4	6	0	18	4	10	7	18	5	3	4	18	5	8	4
19	4	9	0	19	5	1	10	19	5	6	10	19	6	0	1
20	5	0	0	20	5	5	1	20	5	10	5	20	6	3	11
21	5	3	0	21	5	8	4	21	6	1	11	21	6	7	8
22	5	6	0	22	5	11	7	22	6	5	5	22	6	11	6
23	5	9	0	23	6	2	10	23	6	8	11	23	7	3	3
24	6	0	0	24	6	6	1	24	7	0	6	24	7	7	1
25	6	3	0	25	6	9	4	25	7	4	0	25	7	10	11
26	6	6	0	26	7	0	7	26	7	7	6	26	8	2	4
27	6	9	0	27	7	3	10	27	7	11	0	27	8	6	8
28	7	0	0	28	7	7	1	28	8	2	7	28	8	10	3
29	7	3	0	29	7	10	4	29	8	6	1	29	9	2	1
30	7	6	0	30	8	1	7	30	8	9	7	30	9	5	10
31	7	9	0	31	8	4	10	31	9	1	1	31	9	9	8
32	8	0	0	32	8	8	2	32	9	4	8	32	10	1	6
33	8	3	0	33	8	11	5	33	9	8	2	33	10	5	5
34	8	6	0	34	9	2	8	34	9	11	8	34	10	9	1
35	8	9	0	35	9	5	11	35	10	3	2	35	11	0	10
36	9	0	0	36	9	9	2	36	10	6	9	36	11	4	8
37	9	3	0	37	10	0	5	37	10	10	3	37	11	8	5
38	9	6	0	38	10	3	8	38	11	1	9	38	12	0	3
39	9	9	0	39	10	6	11	39	11	5	3	39	12	4	0
40	10	0	0	40	10	10	2	40	11	8	10	40	12	7	10
41	10	3	0	41	11	1	5	41	12	0	4	41	12	11	8
42	10	6	0	42	11	4	8	42	12	3	10	42	13	3	5
43	10	9	0	43	11	7	11	43	12	7	4	43	13	7	3
44	11	0	0	44	11	11	2	44	12	10	11	44	13	11	0
45	11	3	0	45	12	2	5	45	13	2	5	45	14	2	10

Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.				
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	0	9	0	¼	0	0	9	9	¼	0	0	10	6	¼	0	0	11	3
½	0	1	6	0	½	0	1	7	6	½	0	1	9	0	½	0	1	10	6
¾	0	2	3	0	¾	0	2	5	3	¾	0	2	7	6	¾	0	2	9	9

Ft. long	Side 7 in.		
	Ft.	In.	Pa.
1	0	4	1
2	0	8	2
3	1	0	3
4	1	4	4
5	1	8	5
6	2	0	6
7	2	4	7
8	2	8	8
9	3	0	9
10	3	4	10
11	3	8	11
12	4	1	0
13	4	5	1
14	4	9	2
15	5	1	3
16	5	5	4
17	5	9	5
18	6	1	6
19	6	5	7
20	6	9	8
21	7	1	9
22	7	5	10
23	7	9	11
24	8	2	0
25	8	6	1
26	8	10	2
27	9	2	3
28	9	6	4
29	9	10	5
30	10	2	6
31	10	6	7
32	10	10	8
33	11	2	9
34	11	6	10
35	11	10	11
36	12	3	0
37	12	7	1
38	12	11	2
39	13	3	3
40	13	7	4
41	13	11	5
42	14	3	6
43	14	7	7
44	14	11	8
45	15	3	9

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	1	0	3
½	0	2	0	6
¾	0	3	0	9

Ft. long	Side 7¼ in.		
	Ft.	In.	Pa.
1	0	4	4
2	0	8	9
3	1	1	1
4	1	5	6
5	1	9	10
6	2	2	3
7	2	6	7
8	2	11	0
9	3	3	5
10	3	7	9
11	4	0	2
12	4	4	6
13	4	8	11
14	5	1	3
15	5	5	8
16	5	10	1
17	6	2	5
18	6	6	10
19	6	11	2
20	7	3	7
21	7	7	11
22	8	0	4
23	8	4	8
24	8	9	1
25	9	1	6
26	9	5	10
27	9	10	3
28	10	2	7
29	10	7	0
30	10	11	4
31	11	3	9
32	11	8	2
33	12	0	6
34	12	4	11
35	12	9	3
36	13	1	8
37	13	6	0
38	13	10	5
39	14	2	9
40	14	7	2
41	14	11	7
42	15	3	11
43	15	8	4
44	16	0	8
45	16	5	1

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	1	1	0
½	0	2	2	0
¾	0	3	3	0

Ft. long	Side 7½ in.		
	Ft.	In.	Pa.
1	0	4	8
2	0	9	4
3	1	2	0
4	1	6	9
5	1	11	5
6	2	4	1
7	2	8	9
8	3	1	6
9	3	6	2
10	3	10	10
11	4	3	6
12	4	8	3
13	5	0	11
14	5	5	7
15	5	10	3
16	6	3	0
17	6	7	8
18	7	0	4
19	7	5	0
20	7	9	9
21	8	2	5
22	8	7	1
23	8	11	9
24	9	4	6
25	9	9	2
26	10	1	10
27	10	6	6
28	10	11	3
29	11	3	11
30	11	8	7
31	12	1	3
32	12	6	0
33	12	10	8
34	13	3	4
35	13	8	0
36	14	0	9
37	14	5	5
38	14	10	1
39	15	2	9
40	15	7	6
41	16	0	2
42	16	4	10
43	16	9	6
44	17	2	3
45	17	6	11

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	1	2	0
½	0	2	4	0
¾	0	3	6	0

Ft. long	Side 7¾ in.		
	Ft.	In.	Pa.
1	0	5	0
2	0	10	0
3	1	3	0
4	1	8	0
5	2	1	0
6	2	6	0
7	2	11	0
8	3	4	0
9	3	9	0
10	4	2	0
11	4	7	0
12	5	0	0
13	5	5	0
14	5	10	0
15	6	3	0
16	6	8	1
17	7	1	1
18	7	6	1
19	7	11	1
20	8	4	1
21	8	9	1
22	9	2	1
23	9	7	1
24	10	0	1
25	10	5	1
26	10	10	1
27	11	3	1
28	11	8	1
29	12	1	1
30	12	6	1
31	12	11	1
32	13	4	2
33	13	9	2
34	14	2	2
35	14	7	2
36	15	0	2
37	15	5	2
38	15	10	2
39	16	3	2
40	16	8	2
41	17	1	2
42	17	6	2
43	17	11	2
44	18	4	2
45	18	9	2

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	1	3	0
½	0	2	6	0
¾	0	3	9	0

Ft. long	*Side* 8 *in.*			Ft. long	*Side* 8¼ *in.*			Ft. long	*Side* 8½ *in.*			Ft. long	*Side* 8¾ *in.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	5	4	1	0	5	8	1	0	6	0	1	0	6	0
2	0	10	8	2	0	11	4	2	1	0	0	2	1	0	9
3	1	4	0	3	1	5	0	3	1	6	0	3	1	7	1
4	1	9	4	4	1	10	8	4	2	0	1	4	2	1	6
5	2	2	8	5	2	4	4	5	2	6	1	5	2	7	10
6	2	8	0	6	2	10	0	6	3	0	1	6	3	2	3
7	3	1	4	7	3	3	8	7	3	6	1	7	3	8	7
8	3	6	8	8	3	9	4	8	4	0	2	8	4	3	0
9	4	0	0	9	4	3	0	9	4	6	2	9	4	9	5
10	4	5	4	10	4	8	8	10	5	0	2	10	5	3	9
11	4	10	8	11	5	2	4	11	5	6	2	11	5	10	2
12	5	4	0	12	5	8	0	12	6	0	3	12	6	4	6
13	5	9	4	13	6	1	8	13	6	6	3	13	6	10	11
14	6	2	8	14	6	7	4	14	7	0	3	14	7	5	3
15	6	8	0	15	7	1	0	15	7	6	3	15	7	11	8
16	7	1	4	16	7	6	9	16	8	0	4	16	8	6	1
17	7	6	8	17	8	0	5	17	8	6	4	17	9	0	5
18	8	0	0	18	8	6	1	18	9	0	4	18	9	6	10
19	8	5	4	19	8	11	9	19	9	6	4	19	10	1	2
20	8	10	8	20	9	5	5	20	10	0	5	20	10	7	7
21	9	4	0	21	9	11	1	21	10	6	5	21	11	2	11
22	9	9	4	22	10	4	9	22	11	0	5	22	11	8	4
23	10	2	8	23	10	10	5	23	11	6	5	23	12	2	8
24	10	8	0	24	11	4	1	24	12	0	6	24	12	9	1
25	11	1	4	25	11	9	9	25	12	6	6	25	13	3	6
26	11	6	8	26	12	3	5	26	13	0	6	26	13	9	10
27	12	0	0	27	12	9	1	27	13	6	6	27	14	4	3
28	12	5	4	28	13	2	9	28	14	0	7	28	14	10	7
29	12	10	8	29	13	8	5	29	14	6	7	29	15	5	0
30	13	4	0	30	14	2	1	30	15	0	7	30	15	11	4
31	13	9	4	31	14	7	9	31	15	6	7	31	16	5	9
32	14	2	8	32	15	1	6	32	16	0	8	32	17	0	2
33	14	8	0	33	15	7	2	33	16	6	8	33	17	6	6
34	15	1	4	34	16	0	10	34	17	0	8	34	18	0	11
35	15	6	8	35	16	6	6	35	17	6	8	35	18	7	3
36	16	0	0	36	17	0	2	36	18	0	9	36	19	1	8
37	16	5	4	37	17	5	10	37	18	6	9	37	19	8	0
38	16	10	8	38	17	11	6	38	19	0	9	38	20	2	5
39	17	4	0	39	18	5	2	39	19	6	9	39	20	8	9
40	17	9	4	40	18	10	10	40	20	0	10	40	21	3	2
41	18	2	8	41	19	4	6	41	20	6	10	41	21	9	7
42	18	8	0	42	19	10	2	42	21	0	10	42	22	3	11
43	19	1	4	43	20	3	10	43	21	6	10	43	22	10	4
44	19	6	8	44	20	9	6	44	22	0	11	44	23	4	8
45	20	0	0	45	21	3	2	45	22	6	11	45	23	11	0

Quarters of a *Foot.*					*Quarters* of a *Foot.*					*Quarters* of a *Foot.*					*Quarters* of a *Foot.*				
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	1	4	0	¼	0	1	5	0	¼	0	1	6	0	¼	0	1	7	0
½	0	2	8	0	½	0	2	10	0	½	0	3	0	0	½	0	3	2	0
¾	0	4	0	0	¾	0	4	3	0	¾	0	4	6	0	¾	0	4	9	0

Ft. long	Side 9 in. Ft.	In.	Pa.	Ft. long	Side 9¼ in. Ft.	In.	Pa.	Ft. long	Side 9½ in. Ft.	In.	Pa.	Ft. long	Side 9¾ in. Ft.	In.	Pa.
1	0	6	9	1	0	7	1	1	0	7	6	1	0	7	11
2	1	1	6	2	1	2	3	2	1	3	0	2	1	3	10
3	1	8	3	3	1	9	4	3	1	10	6	3	1	11	9
4	2	3	0	4	2	4	6	4	2	6	1	4	2	7	8
5	2	9	9	5	2	11	7	5	3	1	7	5	3	3	7
6	3	4	6	6	3	6	9	6	3	9	1	6	3	11	6
7	3	11	3	7	4	1	10	7	4	4	7	7	4	7	5
8	4	6	0	8	4	9	0	8	5	0	2	8	5	3	4
9	5	0	9	9	5	4	2	9	5	7	8	9	5	11	3
10	5	7	6	10	5	11	3	10	6	3	2	10	6	7	2
11	6	2	3	11	6	6	5	11	6	10	8	11	7	3	1
12	6	9	0	12	7	1	6	12	7	6	3	12	7	11	0
13	7	3	9	13	7	8	8	13	8	1	9	13	8	6	11
14	7	10	6	14	8	3	9	14	8	9	3	14	9	2	10
15	8	5	3	15	8	10	11	15	9	4	9	15	9	10	9
16	9	0	0	16	9	6	1	16	10	0	4	16	10	6	9
17	9	6	9	17	10	1	2	17	10	7	10	17	11	2	8
18	10	1	6	18	10	8	4	18	11	3	4	18	11	10	7
19	10	8	3	19	11	3	5	19	11	10	10	19	12	6	6
20	11	3	0	20	11	10	7	20	12	6	5	20	13	2	5
21	11	9	9	21	12	5	8	21	13	1	11	21	13	10	4
22	12	4	6	22	13	0	10	22	13	9	5	22	14	6	3
23	12	11	3	23	13	7	11	23	14	4	11	23	15	2	2
24	13	6	0	24	14	3	1	24	15	0	6	24	15	10	1
25	14	0	9	25	14	10	3	25	15	8	0	25	16	6	0
26	14	7	6	26	15	5	0	26	16	3	6	26	17	1	11
27	15	2	3	27	16	0	6	27	16	11	0	27	17	9	10
28	15	9	0	28	16	7	7	28	17	6	7	28	18	5	9
29	16	3	9	29	17	2	9	29	18	2	1	29	19	1	8
30	16	10	6	30	17	9	10	30	18	9	7	30	19	9	7
31	17	5	3	31	18	5	0	31	19	5	1	31	20	5	6
32	18	0	0	32	19	0	2	32	20	0	8	32	21	1	6
33	18	6	9	33	19	7	3	33	20	8	2	33	21	9	5
34	19	1	6	34	20	2	5	34	21	3	8	34	22	5	4
35	19	8	3	35	20	9	6	35	21	11	2	35	23	1	3
36	20	3	0	36	21	4	8	36	22	6	9	36	23	9	2
37	20	9	9	37	21	11	9	37	23	2	3	37	24	5	1
38	21	4	6	38	22	6	11	38	23	9	9	38	25	1	0
39	21	11	3	39	23	2	0	39	24	5	3	39	25	8	11
40	22	6	0	40	23	9	2	40	25	0	10	40	26	4	10
41	23	0	9	41	24	4	4	41	25	8	4	41	27	0	9
42	23	7	6	42	24	11	5	42	26	3	10	42	27	8	8
43	24	2	3	43	25	6	7	43	26	11	4	43	28	4	7
44	24	9	0	44	26	1	8	44	27	6	11	44	29	0	6
45	25	3	9	45	26	8	10	45	28	2	5	45	29	8	5

Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	1	8	3	¼	0	1	9	3	¼	0	1	10	6	¼	0	1	11	9
½	0	3	4	6	½	0	3	6	6	½	0	3	9	0	½	0	3	11	6
¾	0	5	0	9	¾	0	5	3	9	¾	0	5	7	6	¾	0	5	11	3

Ft. long	Side 10 in. Ft.	In.	Pa.	Ft. long	Side 10¼ in. Ft.	In.	Pa.	Ft. long	Side 10½ in. Ft.	In.	Pa.	Ft. long	Side 10¾ in. Ft.	In.	Pa.
1	0	8	4	1	0	8	9	1	0	9	2	1	0	9	7
2	1	4	8	2	1	5	6	2	1	6	4	2	1	7	3
3	2	1	0	3	2	2	3	3	2	3	6	3	2	4	10
4	2	9	4	4	2	11	0	4	3	0	9	4	3	2	6
5	3	5	8	5	3	7	9	5	3	9	11	5	4	0	1
6	4	2	0	6	4	4	6	6	4	7	1	6	4	9	9
7	4	10	4	7	5	1	3	7	5	4	3	7	5	7	4
8	5	6	8	8	5	10	0	8	6	1	6	8	6	5	0
9	6	3	0	9	6	6	9	9	6	10	8	9	7	2	7
10	6	11	4	10	7	3	6	10	7	7	10	10	8	0	3
11	7	7	8	11	8	0	3	11	8	5	0	11	8	9	11
12	8	4	0	12	8	9	0	12	9	2	3	12	9	7	6
13	9	0	4	13	9	5	9	13	9	11	5	13	10	5	2
14	9	8	8	14	10	2	5	14	10	8	7	14	11	2	9
15	10	5	0	15	10	11	3	15	11	5	9	15	12	0	5
16	11	1	4	16	11	8	1	16	12	3	0	16	12	10	0
17	11	9	8	17	12	4	10	17	13	0	2	17	13	7	8
18	12	6	0	18	13	1	7	18	13	9	4	18	14	5	4
19	13	2	4	19	13	10	4	19	14	6	6	19	15	2	11
20	13	10	8	20	14	7	1	20	15	3	9	20	16	0	7
21	14	7	0	21	15	3	10	21	16	0	11	21	16	10	2
22	15	3	4	22	16	0	7	22	16	10	1	22	17	7	10
23	15	11	8	23	16	9	4	23	17	7	3	23	18	5	5
24	16	8	0	24	17	6	1	24	18	4	6	24	19	3	1
25	17	4	4	25	18	2	10	25	19	1	8	25	20	0	9
26	18	0	8	26	18	11	7	26	19	10	10	26	20	10	4
27	18	9	0	27	19	8	4	27	20	8	0	27	21	8	0
28	19	5	4	28	20	5	1	28	21	5	3	28	22	5	7
29	20	1	8	29	21	1	10	29	22	2	5	29	23	3	3
30	20	10	0	30	21	10	7	30	22	11	7	30	24	0	10
31	21	6	4	31	22	7	4	31	23	8	9	31	24	10	6
32	22	2	8	32	23	4	2	32	24	6	0	32	25	8	2
33	22	11	0	33	24	0	11	33	25	3	2	33	26	5	9
34	23	7	4	34	24	9	8	34	26	0	4	34	27	3	5
35	24	3	8	35	25	6	5	35	26	9	6	35	28	1	0
36	25	0	0	36	26	3	2	36	27	6	9	36	28	10	8
37	25	8	4	37	26	11	11	37	28	3	11	37	29	8	3
38	26	4	8	38	27	8	8	38	29	1	1	38	30	5	11
39	27	1	0	39	28	5	5	39	29	10	3	39	31	3	6
40	27	9	4	40	29	2	2	40	30	7	6	40	32	1	2
41	28	5	8	41	29	10	11	41	31	4	8	41	32	10	10
42	29	2	0	42	30	7	8	42	32	1	10	42	33	8	5
43	29	10	4	43	31	4	5	43	32	11	0	43	34	6	1
44	30	6	8	44	32	1	2	44	33	8	3	44	35	3	8
45	31	4	0	45	32	9	11	45	34	5	5	45	36	1	4

	Quarters of a Foot. Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.
¼	0	2	1	0	¼	0	2	2	3	¼	0	2	3	6	¼	0	2	4	9
½	0	4	2	0	½	0	4	4	6	½	0	4	7	0	½	0	4	9	6
¾	0	6	3	0	¾	0	6	6	9	¾	0	6	10	6	¾	0	7	2	3

Ft. long	Side 11 in.			Ft. long	Side 11¼ in.			Ft. long	Side 11½ in.			Ft. long	Side 11¾ in.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	10	1	1	0	10	6	1	0	11	0	1	0	11	6
2	1	8	2	2	1	9	1	2	1	10	0	2	1	11	0
3	2	6	3	3	2	7	7	3	2	9	0	3	2	10	6
4	3	4	4	4	3	6	2	4	3	8	1	4	3	10	0
5	4	2	5	5	4	4	8	5	4	7	1	5	4	9	6
6	5	0	6	6	5	3	3	6	5	6	1	6	5	9	0
7	5	10	7	7	6	1	9	7	6	5	1	7	6	8	6
8	6	8	8	8	7	0	4	8	7	4	2	8	7	8	0
9	7	6	9	9	7	10	11	9	8	3	2	9	8	7	6
10	8	4	10	10	8	9	5	10	9	2	2	10	9	7	0
11	9	2	11	11	9	8	0	11	10	1	2	11	10	6	6
12	10	1	0	12	10	6	6	12	11	0	3	12	11	6	0
13	10	11	1	13	11	5	1	13	11	11	3	13	12	5	6
14	11	9	2	14	12	3	7	14	12	10	3	14	13	5	0
15	12	7	3	15	13	2	2	15	13	9	3	15	14	4	6
16	13	5	4	16	14	0	9	16	14	8	4	16	15	4	1
17	14	3	5	17	14	11	3	17	15	7	4	17	16	3	7
18	15	1	6	18	15	9	10	18	16	6	4	18	17	3	1
19	15	11	7	19	16	8	4	19	17	5	4	19	18	2	7
20	16	9	8	20	17	6	11	20	18	4	5	20	19	2	1
21	17	7	9	21	18	5	5	21	19	3	5	21	20	1	7
22	18	5	10	22	19	4	0	22	20	2	5	22	21	1	1
23	19	3	11	23	20	2	6	23	21	1	5	23	22	0	7
24	20	2	0	24	21	1	1	24	22	0	6	24	23	0	1
25	21	0	1	25	21	11	8	25	22	11	6	25	23	11	7
26	21	10	2	26	22	10	2	26	23	10	6	26	24	11	1
27	22	8	3	27	23	8	9	27	24	9	6	27	25	10	7
28	23	6	4	28	24	7	3	28	25	8	7	28	26	10	1
29	24	4	5	29	25	5	10	29	26	7	7	29	27	9	7
30	25	2	6	30	26	4	4	30	27	6	7	30	28	9	1
31	26	0	7	31	27	2	11	31	28	5	7	31	29	8	7
32	26	10	8	32	28	1	6	32	29	4	8	32	30	8	2
33	27	8	9	33	29	0	0	33	30	3	8	33	31	7	8
34	28	6	10	34	29	10	7	34	31	2	8	34	32	7	2
35	29	4	11	35	30	9	1	35	32	1	8	35	33	6	8
36	30	3	0	36	31	7	8	36	33	0	9	36	34	6	2
37	31	1	1	37	32	6	2	37	33	11	9	37	35	5	8
38	31	11	2	38	33	4	9	38	34	10	9	38	36	5	2
39	32	9	3	39	34	3	3	39	35	9	9	39	37	4	8
40	33	7	4	40	35	1	10	40	36	8	10	40	38	4	2
41	34	5	5	41	36	0	5	41	37	7	10	41	39	3	8
42	35	3	6	42	36	10	11	42	38	6	10	42	40	3	2
43	36	1	7	43	37	9	6	43	39	5	10	43	41	2	8
44	36	11	8	44	38	8	0	44	40	4	11	44	42	2	2
45	37	9	9	45	39	6	7	45	41	3	11	45	43	1	8

Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.				
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	2	6	3	¼	0	2	7	6	¼	0	2	9	0	¼	0	2	10	6
½	0	5	0	6	½	0	5	3	0	½	0	5	6	0	½	0	5	9	0
¾	0	7	6	9	¾	0	7	10	6	¾	0	8	3	0	¾	0	8	8	6

Ft. long	Side 12 in.		
	Ft.	In.	Pa.
1	1	0	0
2	2	0	0
3	3	0	0
4	4	0	0
5	5	0	0
6	6	0	0
7	7	0	0
8	8	0	0
9	9	0	0
10	10	0	0
11	11	0	0
12	12	0	0
13	13	0	0
14	14	0	0
15	15	0	0
16	16	0	0
17	17	0	0
18	18	0	0
19	19	0	0
20	20	0	0
21	21	0	0
22	22	0	0
23	23	0	0
24	24	0	0
25	25	0	0
26	26	0	0
27	27	0	0
28	28	0	0
29	29	0	0
30	30	0	0
31	31	0	0
32	32	0	0
33	33	0	0
34	34	0	0
35	35	0	0
36	36	0	0
37	37	0	0
38	38	0	0
39	39	0	0
40	40	0	0
41	41	0	0
42	42	0	0
43	43	0	0
44	44	0	0
45	45	0	0

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	3	0	0
½	0	6	0	0
¾	0	9	0	0

Ft. long	Side 12¼ in.		
	Ft.	In.	Pa.
1	1	0	6
2	2	1	0
3	3	1	6
4	4	2	0
5	5	2	6
6	6	3	0
7	7	3	6
8	8	4	0
9	9	4	6
10	10	5	0
11	11	5	6
12	12	6	0
13	13	6	6
14	14	7	0
15	15	7	6
16	16	8	1
17	17	8	7
18	18	9	1
19	19	9	7
20	20	10	1
21	21	10	7
22	22	11	1
23	23	11	7
24	25	0	1
25	26	0	7
26	27	1	1
27	28	1	7
28	29	2	1
29	30	2	7
30	31	3	1
31	32	3	8
32	33	4	2
33	34	4	8
34	35	5	2
35	36	5	8
36	37	6	2
37	38	6	8
38	39	7	2
39	40	7	8
40	41	8	2
41	42	8	8
42	43	9	2
43	44	9	8
44	45	10	2
45	46	10	8

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	3	1	6
½	0	6	3	0
¾	0	9	4	6

Ft. long	Side 12½ in.		
	Ft.	In.	Pa.
1	1	1	0
2	2	2	0
3	3	3	0
4	4	4	1
5	5	5	1
6	6	6	1
7	7	7	1
8	8	8	2
9	9	9	2
10	10	10	2
11	11	11	2
12	13	0	3
13	14	1	3
14	15	2	3
15	16	3	3
16	17	4	4
17	18	5	4
18	19	6	4
19	20	7	4
20	21	8	5
21	22	9	5
22	23	10	5
23	24	11	5
24	26	0	6
25	27	1	6
26	28	2	6
27	29	3	6
28	30	4	7
29	31	5	7
30	32	6	7
31	33	7	7
32	34	8	8
33	35	9	8
34	36	10	8
35	37	11	8
36	39	0	9
37	40	1	9
38	41	2	9
39	42	3	9
40	43	4	10
41	44	5	10
42	45	6	10
43	46	7	10
44	47	8	11
45	48	9	11

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	3	3	0
½	0	6	6	0
¾	0	9	9	0

Ft. long	Side 12¾ in.		
	Ft.	In.	Pa.
1	1	1	6
2	2	3	1
3	3	4	7
4	4	6	2
5	5	7	8
6	6	9	3
7	7	10	9
8	9	0	4
9	10	1	11
10	11	3	5
11	12	5	0
12	13	6	6
13	14	8	1
14	15	9	7
15	16	11	2
16	18	0	9
17	19	2	3
18	20	3	10
19	21	5	4
20	22	6	11
21	23	8	5
22	24	10	0
23	25	11	6
24	27	1	1
25	28	2	8
26	29	4	2
27	30	5	9
28	31	7	3
29	32	8	10
30	33	10	4
31	34	11	11
32	36	1	6
33	37	3	0
34	38	4	7
35	39	6	1
36	40	7	8
37	41	9	2
38	42	10	9
39	44	0	3
40	45	1	10
41	46	3	5
42	47	4	11
43	48	6	6
44	49	8	0
45	50	9	7

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	3	4	6
½	0	6	9	0
¾	0	10	1	6

Ft. long	Side 13 in.			Ft. long	Side 13¼ in.			Ft. long	Side 13½ in.			Ft. long	Side 13¾ in.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	2	1	1	1	2	7	1	1	3	2	1	1	3	9
2	2	4	2	2	2	5	2	2	2	6	4	2	2	7	6
3	3	6	3	3	3	7	10	3	3	9	6	3	3	11	3
4	4	8	4	4	4	10	6	4	5	0	9	4	5	3	0
5	5	10	5	5	6	1	1	5	6	3	11	5	6	6	9
6	7	0	6	6	7	3	9	6	7	7	1	6	7	10	6
7	8	2	7	7	8	6	4	7	8	10	3	7	9	2	3
8	9	4	8	8	9	9	0	8	10	1	6	8	10	6	0
9	10	6	9	9	10	11	8	9	11	4	8	9	11	9	9
10	11	8	10	10	12	2	3	10	12	7	10	10	13	1	6
11	12	10	11	11	13	4	11	11	13	11	0	11	14	5	3
12	14	1	0	12	14	7	6	12	15	2	3	12	15	9	0
13	15	3	1	13	15	10	2	13	16	5	5	13	17	0	9
14	16	5	2	14	17	0	9	14	17	8	7	14	18	4	6
15	17	7	3	15	18	3	5	15	18	11	9	15	19	8	3
16	18	9	4	16	19	6	1	16	20	3	0	16	21	0	1
17	19	11	5	17	20	8	8	17	21	6	2	17	22	3	10
18	21	1	6	18	21	11	4	18	22	9	4	18	23	7	7
19	22	3	7	19	23	1	11	19	24	0	6	19	24	11	4
20	23	5	8	20	24	4	7	20	25	3	9	20	26	3	1
21	24	7	9	21	25	7	2	21	26	6	11	21	27	6	10
22	25	9	10	22	26	9	10	22	27	10	1	22	28	10	7
23	26	11	11	23	28	0	5	23	29	1	3	23	30	2	4
24	28	2	0	24	29	3	1	24	30	4	6	24	31	6	1
25	29	4	1	25	30	5	9	25	31	7	8	25	32	9	10
26	30	6	2	26	31	8	4	26	32	10	10	26	34	1	7
27	31	8	3	27	32	11	0	27	34	2	0	27	35	5	4
28	32	10	4	28	34	1	7	28	35	5	3	28	36	9	1
29	34	0	5	29	35	4	3	29	36	8	5	29	38	0	10
30	35	2	6	30	36	6	10	30	37	11	7	30	39	4	7
31	36	4	7	31	37	9	6	31	39	2	9	31	40	8	4
32	37	6	8	32	39	0	2	32	40	6	0	32	42	0	2
33	38	8	9	33	40	2	9	33	41	9	2	33	43	3	11
34	39	10	10	34	41	5	5	34	43	0	4	34	44	7	8
35	41	0	11	35	42	8	0	35	44	3	6	35	45	11	5
36	42	3	0	36	43	10	8	36	45	6	9	36	47	3	2
37	43	5	1	37	45	1	3	37	46	9	11	37	48	6	11
38	44	7	2	38	46	3	11	38	48	1	1	38	49	10	8
39	45	9	3	39	47	6	6	39	49	4	3	39	51	2	5
40	46	11	4	40	48	9	2	40	50	7	6	40	52	6	2
41	48	1	5	41	49	11	10	41	51	10	8	41	53	9	11
42	49	3	6	42	51	2	5	42	53	1	10	42	55	1	8
43	50	5	7	43	52	5	1	43	54	5	0	43	56	5	5
44	51	7	8	44	53	7	8	44	55	8	3	44	57	9	2
45	52	9	9	45	54	10	4	45	56	11	5	45	59	0	11

Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.				
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	3	6	3	¼	0	3	7	3	¼	0	3	9	6	¼	0	3	11	3
½	0	7	0	6	½	0	7	3	6	½	0	7	7	0	½	0	7	10	6
¾	0	10	6	9	¾	0	10	11	9	¾	0	11	4	6	¾	0	11	9	9

Ft. long	Side 14 in. Ft.	In.	Pa.
1	1	4	4
2	2	8	8
3	4	1	0
4	5	5	4
5	6	9	8
6	8	2	0
7	9	6	4
8	10	10	8
9	12	3	0
10	13	7	4
11	14	11	8
12	16	4	0
13	17	8	4
14	19	0	8
15	20	5	0
16	21	9	4
17	23	1	8
18	24	6	0
19	25	10	4
20	27	2	8
21	28	7	0
22	29	11	4
23	31	3	8
24	32	8	0
25	34	0	4
26	35	4	8
27	36	9	0
28	38	1	4
29	39	5	8
30	40	10	0
31	42	2	4
32	43	6	8
33	44	11	0
34	46	3	4
35	47	7	8
36	49	0	0
37	50	4	4
38	51	8	8
39	53	1	0
40	54	5	4
41	55	9	8
42	57	2	0
43	58	6	4
44	59	10	8
45	61	3	0

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	4	1	0
½	0	8	2	0
¾	1	0	3	0

Ft. long	Side 14¼ in. Ft.	In.	Pa.
1	1	4	11
2	2	9	10
3	4	2	9
4	5	7	8
5	7	0	7
6	8	5	6
7	9	10	5
8	11	3	4
9	12	8	3
10	14	1	2
11	15	6	1
12	16	11	0
13	18	3	11
14	19	8	10
15	21	1	9
16	22	6	9
17	23	11	8
18	25	4	7
19	26	9	6
20	28	2	5
21	29	7	4
22	31	0	3
23	32	5	2
24	33	10	1
25	35	3	0
26	36	7	11
27	38	0	10
28	39	5	9
29	40	10	8
30	42	3	7
31	43	8	6
32	45	1	6
33	46	6	5
34	47	11	4
35	49	4	3
36	50	9	2
37	52	2	1
38	53	7	0
39	54	11	11
40	56	4	10
41	57	9	9
42	59	2	8
43	60	7	7
44	62	0	6
45	63	5	5

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	4	2	9
½	0	8	5	6
¾	1	0	8	3

Ft. long	Side 14½ in. Ft.	In.	Pa.
1	1	5	6
2	2	11	0
3	4	4	6
4	5	10	1
5	7	3	7
6	8	9	1
7	10	2	7
8	11	8	2
9	13	1	8
10	14	7	2
11	16	0	8
12	17	6	3
13	18	11	9
14	20	5	3
15	21	10	9
16	23	4	4
17	24	9	10
18	26	3	4
19	27	8	10
20	29	2	5
21	30	7	11
22	32	1	5
23	33	6	11
24	35	0	6
25	36	6	0
26	37	11	6
27	39	5	0
28	40	10	7
29	42	4	1
30	43	9	7
31	45	3	1
32	46	8	8
33	48	2	2
34	49	7	8
35	51	1	2
36	52	6	9
37	54	0	3
38	55	5	9
39	56	11	3
40	58	4	10
41	59	10	4
42	61	3	10
43	62	9	4
44	64	2	11
45	65	8	5

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	4	4	6
½	0	8	9	0
¾	1	1	1	6

Ft. long	Side 14¾ in. Ft.	In.	Pa.
1	1	6	1
2	3	0	3
3	4	6	4
4	6	0	6
5	7	6	7
6	9	0	9
7	10	6	10
8	12	1	0
9	13	7	2
10	15	1	3
11	16	7	5
12	18	1	6
13	19	7	8
14	21	1	9
15	22	7	11
16	24	2	1
17	25	8	2
18	27	2	4
19	28	8	5
20	30	2	7
21	31	8	1
22	33	2	10
23	34	8	11
24	36	3	1
25	37	9	3
26	39	3	4
27	40	9	6
28	42	3	7
29	43	9	9
30	45	3	10
31	46	10	0
32	48	4	2
33	49	10	3
34	51	4	5
35	52	10	6
36	54	4	8
37	55	10	9
38	57	4	11
39	58	11	0
40	60	5	2
41	61	11	4
42	63	5	5
43	64	11	7
44	66	5	8
45	67	11	10

Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	4	6	3
½	0	9	0	6
¾	1	1	6	9

Ft. long	*Side 15 in.* Ft.	In.	Pa.	*Ft. long*	*Side 15¼ in.* Ft.	In.	Pa.	*Ft. long*	*Side 15½ in.* Ft.	In.	Pa.	*Ft. long*	*Side 15¾ in.* Ft.	In.	Pa.
1	1	6	9	1	1	7	4	1	1	8	0	1	1	8	8
2	3	1	6	2	3	2	9	2	3	4	0	2	3	5	4
3	4	8	3	3	4	10	1	3	5	0	0	3	5	2	0
4	6	3	0	4	6	5	6	4	6	8	1	4	6	10	8
5	7	9	9	5	8	0	10	5	8	4	1	5	8	7	4
6	9	4	6	6	9	8	3	6	10	0	1	6	10	4	0
7	10	11	3	7	11	3	7	7	11	8	1	7	12	0	8
8	12	6	0	8	12	11	0	8	13	4	2	8	13	9	4
9	14	0	9	9	14	6	5	9	15	0	2	9	15	6	0
10	15	7	6	10	16	1	9	10	16	8	2	10	17	2	8
11	17	2	3	11	17	9	2	11	18	4	2	11	18	11	4
12	18	9	0	12	19	4	6	12	20	0	3	12	20	8	0
13	20	3	9	13	20	11	11	13	21	8	3	13	22	4	8
14	21	10	6	14	22	7	3	14	23	4	3	14	24	1	4
15	23	5	3	15	24	2	8	15	25	0	3	15	25	10	0
16	25	0	0	16	25	10	1	16	26	8	4	16	27	6	9
17	26	6	9	17	27	5	5	17	28	4	4	17	29	3	5
18	28	1	6	18	29	0	10	18	30	0	4	18	31	0	1
19	29	8	3	19	30	8	2	19	31	8	4	19	32	8	9
20	31	3	0	20	32	3	7	20	33	4	5	20	34	5	5
21	32	9	9	21	33	10	11	21	35	0	5	21	36	2	1
22	34	4	6	22	35	6	4	22	36	8	5	22	37	10	9
23	35	11	3	23	37	1	8	23	38	4	5	23	39	7	5
24	37	6	0	24	38	9	1	24	40	0	6	24	41	4	1
25	39	0	9	25	40	4	6	25	41	8	6	25	43	0	9
26	40	7	6	26	41	11	10	26	43	4	6	26	44	9	5
27	42	2	3	27	43	7	3	27	45	0	6	27	46	6	1
28	43	9	0	28	45	2	7	28	46	8	7	28	48	2	9
29	45	3	9	29	46	10	0	29	48	4	7	29	49	11	5
30	46	10	6	30	48	5	4	30	50	0	7	30	51	8	1
31	48	5	3	31	50	0	9	31	51	8	7	31	53	4	9
32	50	0	0	32	51	8	2	32	53	4	8	32	55	1	6
33	51	6	9	33	53	3	6	33	55	0	8	33	56	10	2
34	53	1	6	34	54	10	11	34	56	8	8	34	58	6	10
35	54	8	3	35	56	6	3	35	58	4	8	35	60	3	6
36	56	3	0	36	58	1	8	36	60	0	9	36	62	0	2
37	57	9	9	37	59	9	0	37	61	8	9	37	63	8	10
38	59	4	6	38	61	4	5	38	63	4	9	38	65	5	6
39	60	11	3	39	62	11	9	39	65	0	9	39	67	2	2
40	62	6	0	40	64	7	2	40	66	8	10	40	68	10	10
41	64	0	9	41	66	2	7	41	68	4	10	41	70	7	6
42	65	7	6	42	67	9	11	42	70	0	10	42	72	4	2
43	67	2	3	43	69	5	4	43	71	8	10	43	74	0	10
44	68	9	0	44	71	0	8	44	73	4	11	44	75	9	6
45	70	3	9	45	72	8	1	45	75	0	11	45	77	6	2

	Quarters of a Foot. Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.		*Quarters of a Foot.* Ft.	In.	Pa.	S.
¼	0	4	8	3	¼	0	4	10	0	¼	0	5	0	0	¼	0	5	2	0
½	0	9	4	6	½	0	9	8	0	½	0	10	0	0	½	0	10	4	0
¾	1	2	0	9	¾	1	2	6	0	¾	1	3	0	0	¾	1	3	6	0

Ft. long	Side 16 in.			Ft. long	Side 16¼ in.			Ft. long	Side 16½ in.			Ft. long	Side 16¾ in		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	9	4	1	1	10	0	1	1	10	8	1	1	11	4
2	3	6	8	2	3	8	0	2	3	9	4	2	3	10	9
3	5	4	0	3	5	6	0	3	5	8	0	3	5	10	1
4	7	1	4	4	7	4	0	4	7	6	9	4	7	9	6
5	8	10	8	5	9	2	0	5	9	5	5	5	9	8	10
6	10	8	0	6	11	0	0	6	11	4	1	6	11	9	3
7	12	5	4	7	12	10	0	7	13	2	9	7	13	7	7
8	14	2	8	8	14	8	0	8	15	1	6	8	15	7	0
9	16	0	0	9	16	6	0	9	17	0	2	9	17	6	5
10	17	9	4	10	18	4	0	10	18	10	10	10	19	5	9
11	19	6	8	11	20	2	0	11	20	9	6	11	21	5	2
12	21	4	0	12	22	0	0	12	22	8	3	12	23	4	6
13	23	1	4	13	23	10	0	13	24	6	11	13	25	3	11
14	24	10	8	14	25	8	0	14	26	5	7	14	27	3	3
15	26	8	0	15	27	6	0	15	28	4	3	15	29	2	8
16	28	5	4	16	29	4	1	16	30	3	0	16	31	2	1
17	30	2	8	17	31	2	1	17	32	1	8	17	33	1	5
18	32	0	0	18	33	0	1	18	34	0	3	18	35	0	10
19	33	9	4	19	34	10	1	19	35	11	0	19	37	0	2
20	35	6	8	20	36	8	1	20	37	9	9	20	38	11	7
21	37	4	0	21	38	6	1	21	39	8	5	21	40	10	11
22	39	1	4	22	40	4	1	22	41	7	1	22	42	10	4
23	40	10	8	23	42	2	1	23	43	5	9	23	44	9	8
24	42	8	0	24	44	0	1	24	45	4	6	24	46	9	1
25	44	5	4	25	45	10	1	25	47	3	2	25	48	8	6
26	46	2	8	26	47	8	1	26	49	1	10	26	50	7	10
27	48	0	0	27	49	6	1	27	51	0	6	27	52	7	3
28	49	9	4	28	51	4	1	28	52	11	3	28	54	6	7
29	51	6	8	29	53	2	1	29	54	9	11	29	56	6	0
30	53	4	0	30	55	0	1	30	56	8	7	30	58	5	4
31	55	1	4	31	56	10	1	31	58	7	3	31	60	4	9
32	56	10	8	32	58	8	2	32	60	6	0	32	62	4	2
33	58	8	0	33	60	6	2	33	62	4	8	33	64	3	6
34	60	5	4	34	62	4	2	34	64	3	4	34	66	2	11
35	62	2	8	35	64	2	2	35	66	2	0	35	68	2	3
36	64	0	0	36	66	0	2	36	68	0	9	36	70	1	8
37	65	9	4	37	67	10	2	37	69	11	5	37	72	1	0
38	67	6	8	38	69	8	2	38	71	10	1	38	74	0	5
39	69	4	0	39	71	6	2	39	73	8	9	39	75	11	9
40	71	1	4	40	73	4	2	40	75	7	6	40	77	11	2
41	72	10	8	41	75	2	2	41	77	6	2	41	79	10	7
42	74	8	0	42	77	0	2	42	79	4	10	42	81	9	11
43	76	4	4	43	78	10	2	43	81	3	6	43	83	9	4
44	78	2	8	44	80	8	2	44	83	2	3	44	85	8	8
45	80	0	0	45	82	6	2	45	85	0	11	45	87	8	1

	Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.					Quarters of a Foot.			
	Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.		Ft.	In.	Pa.	S.
¼	0	5	4	0	¼	0	5	6	0	¼	0	5	8	0	¼	0	5	10	0
½	0	10	8	0	½	0	11	0	0	½	0	11	4	0	½	0	11	8	0
¾	1	4	0	0	¾	1	4	6	0	¾	1	5	0	0	¾	1	5	6	0

Ft. long	Side 17 in. Ft.	In.	Pa.	Ft. long	Side 17¼ in. Ft.	In.	Pa.	Ft. long	Side 17½ in. Ft.	In.	Pa.	Ft. long	Side 17¾ in. Ft.	In.	Pa.
1	2	0	1	1	2	0	9	1	2	1	6	1	2	2	3
2	4	0	2	2	4	1	7	2	4	3	0	2	4	4	6
3	6	0	3	3	6	2	4	3	6	4	6	3	6	6	9
4	8	0	4	4	8	3	2	4	8	6	1	4	8	9	0
5	10	0	5	5	10	3	11	5	10	7	7	5	10	11	3
6	12	0	6	6	12	4	9	6	12	9	1	6	13	1	6
7	14	0	7	7	14	5	6	7	14	10	7	7	15	3	9
8	16	0	8	8	16	6	4	8	17	0	2	8	17	6	0
9	18	0	9	9	18	7	2	9	19	1	8	9	19	8	3
10	20	0	10	10	20	7	11	10	21	3	2	10	21	10	6
11	22	0	11	11	22	8	9	11	23	4	8	11	24	0	9
12	24	1	0	12	24	9	6	12	25	6	3	12	26	3	0
13	26	1	1	13	26	10	4	13	27	7	9	13	28	5	3
14	28	1	2	14	28	11	1	14	29	9	3	14	30	7	6
15	30	1	3	15	30	11	11	15	31	10	9	15	32	9	9
16	32	1	4	16	33	0	9	16	34	0	4	16	35	0	1
17	34	1	5	17	35	1	6	17	36	1	10	17	37	2	4
18	36	1	6	18	37	2	4	18	38	3	4	18	39	4	7
19	38	1	7	19	39	3	1	19	40	4	10	19	41	6	10
20	40	1	8	20	41	3	11	20	42	6	5	20	43	9	1
21	42	1	9	21	43	4	8	21	44	7	11	21	45	11	4
22	44	1	10	22	45	5	6	22	46	9	5	22	48	1	7
23	46	1	11	23	47	6	3	23	48	10	11	23	50	3	10
24	48	2	0	24	49	7	1	24	51	0	6	24	52	6	1
25	50	2	1	25	51	7	11	25	53	2	0	25	54	8	4
26	52	2	2	26	53	8	8	26	55	3	6	26	56	10	7
27	54	2	3	27	55	9	6	27	57	5	0	27	59	0	10
28	56	2	4	28	57	10	3	28	59	6	7	28	61	3	1
29	58	2	5	29	59	11	1	29	61	8	1	29	63	5	4
30	60	2	6	30	61	11	10	30	63	9	7	30	65	7	7
31	62	2	7	31	64	0	8	31	65	11	1	31	67	9	10
32	64	2	8	32	66	1	6	32	68	0	8	32	70	0	2
33	66	2	9	33	68	2	3	33	70	2	2	33	72	2	5
34	68	2	10	34	70	3	1	34	72	3	8	34	74	4	8
35	70	2	11	35	72	3	10	35	74	5	2	35	76	6	11
36	72	3	0	36	74	4	8	36	76	6	9	36	78	9	2
37	74	3	1	37	76	5	5	37	78	8	3	37	80	11	5
38	76	3	2	38	78	6	3	38	80	9	9	38	83	1	8
39	78	3	3	39	80	7	0	39	82	11	3	39	85	3	11
40	80	3	4	40	82	7	10	40	85	0	10	40	87	6	2
41	82	3	5	41	84	8	8	41	87	2	4	41	89	8	5
42	84	3	6	42	86	9	5	42	89	3	10	42	91	10	8
43	86	3	7	43	88	10	3	43	91	5	4	43	94	0	11
44	88	3	8	44	90	11	0	44	93	6	11	44	96	3	2
45	90	3	9	45	92	11	10	45	95	8	5	45	98	5	5

Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.	Quarters of a Foot.	Ft.	In.	Pa.	S.
¼	0	6	0	3	¼	0	6	2	3	¼	0	6	4	6	¼	0	6	6	9
½	1	0	0	6	½	1	0	4	6	½	1	0	9	0	½	1	1	1	6
¾	1	6	0	9	¾	1	6	6	9	¾	1	7	1	6	¾	1	7	8	3

Ft. long	Side 18 in.			Ft. long	Side 18 in.			Ft. long	Side 18 in.			Ft. long	Side 18 in.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	2	3	0	14	31	6	0	27	60	9	0	40	90	0	0
2	4	6	0	15	33	9	0	28	63	0	0	41	92	3	0
3	6	9	0	16	36	0	0	29	65	3	0	42	94	6	0
4	9	0	0	17	38	3	0	30	67	6	0	43	96	9	0
5	11	3	0	18	40	6	0	31	69	9	0	44	99	0	0
6	13	6	0	19	42	9	0	32	72	0	0	45	101	3	0
7	15	9	0	20	45	0	0	33	74	3	0				
8	18	0	0	21	47	3	0	34	76	6	0				
9	20	3	0	22	49	6	0	35	78	9	0				
10	22	6	0	23	51	9	0	36	81	0	0				
11	24	9	0	24	54	0	0	37	83	3	0				
12	27	0	0	25	56	3	0	38	85	6	0				
13	29	3	0	26	58	6	0	39	87	9	0				

Quarters of a *Foot.*

	Ft.	In.	Pa.	S.
¼	0	6	9	0
½	1	1	6	0
¾	1	8	3	0

TABLE III.

VALUE OF SCANTLINGS.

THESE Tables, which are eight in number, but all of the same nature, and only differing in price, show the value per lineal foot of timber, stone, &c., cut to any size or scantling, at the several prices from 1*s*. 6*d*. to 5*s*. per foot cube; and by addition or subtraction only, will show the value at any greater or less prices.

The figures at the left hand of each Table represent the thickness and breadth of the piece to be valued; and the figures at the right hand of each Table show the value of 1 foot in length of it, at the price per cubic foot stated at the head of the Table.

In the Tables at 1*s*. 6*d*., 2*s*., and 2*s*. 6*d*., the value is given in *pence* and *eighths* of a penny; but in the other Tables the value is given in *pence* and *farthings*.

Example I.—To find the value of 1 foot in length of a piece whose scantling is 6 ins. by 9 ins., at 2*s*. per foot cube. In the Table at 2*s*., look for 6 ins. by 9 ins., and against it stands 9*d*., the value sought.

Example II.—To find the value of 1 foot in length of a piece whose scantling is larger than the extent of the Table, seek for the value of 1 foot whose scantlings are each of them half the given scantlings; and four times that price is the value sought.

In.	In.	d.	⅛
2 by	2	0	4
	2½	0	5
	3	0	6
	3½	0	7
	4	1	0
	4½	1	1
	5	1	2
	5½	1	3
	6	1	4
	6½	1	5
	7	1	6
	7½	1	7
	8	2	0
	8½	2	1
	9	2	2
	9½	2	3
	10	2	4
	10½	2	5
	11	2	6
	11½	2	7
	12	3	0
2½ by	2½	0	6
	3	0	7
	3½	1	0
	4	1	2
	4½	1	3
	5	1	4
	5½	1	5
	6	1	7
	6½	2	0
	7	2	1
	7½	2	2
	8	2	4
	8½	2	5
	9	2	6
	9½	2	7
	10	3	1
	10½	3	2
	11	3	3
	11½	3	4
	12	3	6
3 by	3	1	1
	3½	1	2
	4	1	4
	4½	1	5
	5	1	7
	5½	2	0
	6	2	2
	6½	2	3
	7	2	5
	7½	2	6
	8	3	0
	8½	3	1
	9	3	3
	9½	3	4
	10	3	6
	10½	3	7
	11	4	1
	11½	4	2
	12	4	4

In.	In.	d.	⅛
3½ by	3½	1	4
	4	1	6
	4½	1	7
	5	2	1
	5½	2	3
	6	2	5
	6½	2	7
	7	3	0
	7½	3	2
	8	3	4
	8½	3	5
	9	3	7
	9½	4	1
	10	4	3
	10½	4	4
	11	4	6
	11½	5	0
	12	5	2
4 by	4	2	0
	4½	2	2
	5	2	4
	5½	2	6
	6	3	0
	6½	3	2
	7	3	4
	7½	3	6
	8	4	0
	8½	4	2
	9	4	4
	9½	4	6
	10	5	0
	10½	5	2
	11	5	4
	11½	5	6
	12	6	0
4½ by	4½	2	4
	5	2	6
	5½	3	0
	6	3	3
	6½	3	5
	7	3	7
	7½	4	1
	8	4	4
	8½	4	6
	9	5	0
	9½	5	2
	10	5	5
	10½	5	7
	11	6	1
	11½	6	3
	12	6	6
5 by	5	3	1
	5½	3	3
	6	3	6
	6½	4	0
	7	4	3
	7½	4	5
	8	5	0
	8½	5	2

In.	In.	d.	⅛
5 by	9	5	5
	9½	5	7
	10	6	2
	10½	6	4
	11	6	7
	11½	7	1
	12	7	4
5½ by	5½	3	6
	6	4	1
	6½	4	3
	7	4	6
	7½	5	1
	8	5	4
	8½	5	6
	9	6	1
	9½	6	4
	10	6	7
	10½	7	1
	11	7	4
	11½	7	7
	12	8	2
6 by	6	4	4
	6½	4	7
	7	5	2
	7½	5	5
	8	6	0
	8½	6	3
	9	6	6
	9½	7	1
	10	7	4
	10½	7	7
	11	8	2
	11½	8	5
	12	9	0
6½ by	6½	5	2
	7	5	5
	7½	6	0
	8	6	4
	8½	6	7
	9	7	2
	9½	7	5
	10	8	1
	10½	8	4
	11	8	7
	11½	9	2
	12	9	6
7 by	7	6	1
	7½	6	4
	8	7	0
	8½	7	3
	9	7	7
	9½	8	2
	10	8	6
	10½	9	1
	11	9	5
	11½	10	0
	12	10	4

In.	In.	d.	⅛
7½ by	7½	7	0
	8	7	4
	8½	7	7
	9	8	3
	9½	8	7
	10	9	3
	10½	9	6
	11	10	2
	11½	10	6
	12	11	2
8 by	8	8	0
	8½	8	4
	9	9	0
	9½	9	4
	10	10	0
	10½	10	4
	11	11	0
	11½	11	4
	12	12	0
8½ by	8½	9	0
	9	9	4
	9½	10	0
	10	10	5
	10½	11	1
	11	11	5
	11½	12	1
	12	12	6
9 by	9	10	1
	9½	10	5
	10	11	2
	10½	11	6
	11	12	3
	11½	12	7
	12	13	4
9½ by	9½	11	2
	10	11	7
	10½	12	3
	11	13	0
	11½	13	5
	12	14	2
10 by	10	12	4
	10½	13	1
	11	13	6
	11½	14	3
	12	15	0
10½ by	10½	13	6
	11	14	3
	11½	15	0
	12	15	6
11 by	11	15	1
	11½	15	6
	12	16	4
11½ by	11½	16	4
	12	17	2

In.	In.	d.	1/8
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	1	0
	[illegible]	1	1
	4	1	3
	4½	1	4
	5	1	5
	5½	1	7
	6	2	0
	6½	2	1
	7	2	2
	7½	2	4
	8	2	5
	8½	2	6
	9	3	0
	9½	3	1
	10	3	2
	10½	3	4
	11	3	5
	11½	3	6
	12	4	0
2½ by	2½	1	0
	3	1	2
	3½	1	3
	4	1	5
	4½	1	7
	5	2	0
	5½	2	2
	6	2	4
	6½	2	5
	7	2	6
	7½	3	0
	8	3	2
	8½	3	4
	9	3	6
	9½	3	7
	10	4	1
	10½	4	3
	11	4	4
	11½	4	6
	12	5	0
3 by	3	1	4
	3½	1	6
	4	2	0
	4½	2	2
	5	2	4
	5½	2	6
	6	3	0
	6½	3	2
	7	3	4
	7½	3	6
	8	4	0
	8½	4	2
	9	4	4
	9½	4	6
	10	5	0
	10½	5	2
	11	5	4
	11½	5	6
	12	6	0

In.	In.	d.	1/8
3½ by	3½	2	0
	4	2	2
	4½	2	5
	5	2	7
	5½	3	2
	6	3	4
	6½	3	6
	7	4	0
	7½	4	3
	8	4	5
	8½	4	7
	9	5	2
	9½	5	4
	10	5	6
	10½	5	7
	11	6	2
	11½	6	5
	12	7	0
4 by	4	2	5
	4½	3	0
	5	3	2
	5½	3	5
	6	4	0
	6½	4	2
	7	4	5
	7½	5	0
	8	5	2
	8½	5	5
	9	6	0
	9½	6	2
	10	6	5
	10½	7	0
	11	7	2
	11½	7	5
	12	8	0
4½ by	4½	3	3
	5	3	6
	5½	4	1
	6	4	4
	6½	4	7
	7	5	2
	7½	5	5
	8	6	0
	8½	6	3
	9	6	6
	9½	7	1
	10	7	4
	10½	7	7
	11	8	2
	11½	8	6
	12	9	0
5 by	5	4	1
	5½	4	4
	6	5	0
	6½	5	3
	7	5	6
	7½	6	2
	8	6	5
	8½	7	0

In.	In.	d.	1/8
5 by	9	7	4
	9½	7	7
	10	8	2
	10½	8	6
	11	9	1
	11½	9	4
	12	10	0
5½ by	5½	5	0
	6	5	4
	6½	5	7
	7	6	2
	7½	6	7
	8	7	2
	8½	7	6
	9	8	2
	9½	8	5
	10	9	1
	10½	9	5
	11	10	0
	11½	10	4
	12	11	0
6 by	6	6	0
	6½	6	4
	7	7	0
	7½	7	4
	8	8	0
	8½	8	4
	9	9	0
	9½	9	4
	10	10	0
	10½	10	4
	11	11	0
	11½	11	4
	12	12	0
6½ by	6½	7	0
	7	7	4
	7½	8	0
	8	8	5
	8½	9	1
	9	9	6
	9½	10	2
	10	10	6
	10½	11	3
	11	11	7
	11½	12	3
	12	13	0
7 by	7	8	1
	7½	8	6
	8	9	2
	8½	9	7
	9	10	4
	9½	11	0
	10	11	5
	10½	12	2
	11	12	6
	11½	13	3
	12	14	0

In.	In.	d.	1/8
7½ by	7½	9	3
	8	10	0
	8½	10	4
	9	11	2
	9½	11	7
	10	12	4
	10½	13	1
	11	13	6
	11½	14	3
	12	15	0
8 by	8	10	5
	8½	11	2
	9	12	0
	9½	12	5
	10	13	2
	10½	14	0
	11	14	5
	11½	15	2
	12	16	0
8½ by	8½	12	0
	9	12	6
	9½	13	3
	10	14	1
	10½	14	7
	11	15	4
	11½	16	2
	12	17	0
9 by	9	13	4
	9½	14	2
	10	15	0
	10½	15	6
	11	16	4
	11½	17	2
	12	18	0
9½ by	9½	15	0
	10	15	6
	10½	16	4
	11	17	3
	11½	18	2
	12	19	0
10 by	10	16	5
	10½	17	4
	11	18	2
	11½	19	1
	12	20	0
10½ by	10½	18	3
	11	19	2
	11½	20	1
	12	21	0
11 by	11	20	0
	11½	21	0
	12	22	0
11½ by	11½	22	0
	12	23	0

In.	In.	d.	⅛
2 by	2	0	7
	2½	1	0
	3	1	1
	3½	1	3
	4	1	5
	4½	1	6
	5	2	0
	5½	2	2
	6	2	4
	6½	2	6
	7	2	7
	7½	3	0
	8	3	2
	8½	3	4
	9	3	6
	9½	3	7
	10	4	0
	10½	4	2
	11	4	4
	11½	4	6
	12	5	0
2½ by	2½	1	2
	3	1	4
	3½	1	5
	4	2	0
	4½	2	1
	5	2	4
	5½	2	5
	6	3	0
	6½	3	1
	7	3	3
	7½	3	6
	8	4	0
	8½	4	2
	9	4	3
	9½	4	5
	10	5	0
	10½	5	1
	11	5	3
	11½	5	6
	12	6	2
3 by	3	1	7
	3½	2	1
	4	2	4
	4½	2	6
	5	3	1
	5½	3	3
	6	3	6
	6½	4	0
	7	4	2
	7½	4	4
	8	5	0
	8½	5	2
	9	5	4
	9½	5	7
	10	6	2
	10½	6	4
	11	6	7
	11½	7	0
	12	7	4

In.	In.	d.	⅛
3½ by	3½	2	4
	4	2	7
	4½	3	1
	5	3	4
	5½	4	0
	6	4	2
	6½	4	5
	7	5	0
	7½	5	4
	8	5	6
	8½	6	0
	9	6	3
	9½	6	7
	10	7	2
	10½	7	4
	11	7	7
	11½	8	3
	12	8	6
4 by	4	3	2
	4½	3	7
	5	4	1
	5½	4	4
	6	5	0
	6½	5	2
	7	5	6
	7½	6	2
	8	6	4
	8½	7	0
	9	7	2
	9½	7	6
	10	8	1
	10½	8	4
	11	9	0
	11½	9	4
	12	10	0
4½ by	4½	4	2
	5	4	4
	5½	5	0
	6	5	4
	6½	6	0
	7	6	3
	7½	6	6
	8	7	2
	8½	7	6
	9	8	2
	9½	8	5
	10	9	0
	10½	9	4
	11	9	7
	11½	10	2
	12	11	0
5 by	5	5	0
	5½	5	5
	6	6	2
	6½	6	5
	7	7	2
	7½	7	5
	8	8	1
	8½	8	5

In.	In.	d.	⅛
5 by	9	9	2
	9½	9	5
	10	10	2
	10½	10	5
	11	11	1
	11½	11	5
	12	12	4
5½ by	5½	6	2
	6	6	7
	6½	7	2
	7	7	7
	7½	8	3
	8	9	0
	8½	9	3
	9	10	0
	9½	10	4
	10	11	2
	10½	11	5
	11	12	1
	11½	12	6
	12	13	6
6 by	6	7	4
	6½	8	0
	7	8	4
	7½	9	0
	8	10	0
	8½	10	5
	9	11	2
	9½	11	7
	10	12	4
	10½	13	1
	11	13	6
	11½	14	2
	12	15	0
6½ by	6½	8	6
	7	9	2
	7½	10	0
	8	10	7
	8½	11	3
	9	12	0
	9½	12	6
	10	13	2
	10½	13	7
	11	14	2
	11½	15	0
	12	16	2
7 by	7	10	1
	7½	10	7
	8	11	4
	8½	12	1
	9	13	1
	9½	13	6
	10	14	4
	10½	15	3
	11	16	0
	11½	16	6
	12	17	4

In.	In.	d.	⅛
7½ by	7½	11	6
	8	12	5
	8½	13	1
	9	14	0
	9½	14	6
	10	15	5
	10½	16	3
	11	17	1
	11½	17	7
	12	18	6
8 by	8	13	2
	8½	14	0
	9	15	0
	9½	15	6
	10	16	4
	10½	17	4
	11	18	2
	11½	19	0
	12	20	0
8½ by	8½	15	0
	9	15	7
	9½	16	5
	10	17	5
	10½	18	4
	11	19	2
	11½	20	2
	12	21	2
9 by	9	16	7
	9½	17	7
	10	18	6
	10½	19	2
	11	20	5
	11½	21	4
	12	22	4
9½ by	9½	18	6
	10	19	5
	10½	20	5
	11	21	5
	11½	22	6
	12	23	6
10 by	10	20	6
	10½	21	7
	11	22	7
	11½	23	7
	12	25	0
10½ by	10½	22	7
	11	24	0
	11½	25	1
	12	26	2
11 by	11	25	0
	11½	26	2
	12	27	4
11½ by	11½	27	6
	12	28	0

In.	In.	s.	d.
2 by	2	0	1
	2½	0	1¼
	3	0	1½
	3½	0	1¾
	4	0	2
	4½	0	2¼
	5	0	2½
	5½	0	2¾
	6	0	3
	6½	0	3¼
	7	0	3½
	7½	0	3¾
	8	0	4
	8½	0	4¼
	9	0	4½
	9½	0	4¾
	10	0	5
	10½	0	5¼
	11	0	5½
	11½	0	5¾
	12	0	6
2½ by	2½	0	1½
	3	0	1¾
	3½	0	2
	4	0	2½
	4½	0	2¾
	5	0	3
	5½	0	3¼
	6	0	3¾
	6½	0	4
	7	0	4¼
	7½	0	4½
	8	0	5
	8½	0	5¼
	9	0	5½
	9½	0	5¾
	10	0	6¼
	10½	0	6½
	11	0	6¾
	11½	0	7
	12	0	7½
3 by	3	0	2¼
	3½	0	2¾
	4	0	3
	4½	0	3½
	5	0	3¾
	5½	0	4¼
	6	0	4½
	6½	0	5
	7	0	5¼
	7½	0	5¾
	8	0	6
	8½	0	6¼
	9	0	6¾
	9½	0	7¼
	10	0	7½
	10½	0	8
	11	0	8¼
	11½	0	8¾
	12	0	9

In.	In.	s.	d.
3½ by	3½	0	3
	4	0	3½
	4½	0	3¾
	5	0	4¼
	5½	0	4¾
	6	0	5¼
	6½	0	5½
	7	0	6
	7½	0	6½
	8	0	7
	8½	0	7¼
	9	0	7¾
	9½	0	8¼
	10	0	8¾
	10½	0	9
	11	0	9½
	11½	0	10
	12	0	10½
4 by	4	0	4
	4½	0	4½
	5	0	5
	5½	0	5½
	6	0	6
	6½	0	6½
	7	0	7
	7½	0	7½
	8	0	8
	8½	0	8½
	9	0	9
	9½	0	9½
	10	0	10
	10½	0	10½
	11	0	11
	11½	0	11½
	12	1	0
4½ by	4½	0	5
	5	0	5½
	5½	0	6
	6	0	6¾
	6½	0	7¼
	7	0	7¾
	7½	0	8¼
	8	0	9
	8½	0	9½
	9	0	10
	9½	0	10½
	10	0	11¼
	10½	0	11¾
	11	1	0¼
	11½	1	0¾
	12	1	1¼
5 by	5	0	6½
	5½	0	7
	6	0	7½
	6½	0	8¼
	7	0	8¾
	7½	0	9½
	8	0	10
	8½	0	10¾

In.	In.	s.	d.
5 by	9	0	11¼
	9½	1	0
	10	1	0½
	10½	1	1¼
	11	1	1¾
	11½	1	2¼
	12	1	3
5½ by	5½	0	7½
	6	0	8¼
	6½	0	8¾
	7	0	9½
	7½	0	10¼
	8	0	11
	8½	0	11½
	9	1	0¼
	9½	1	1
	10	1	1¾
	10½	1	2¼
	11	1	3
	11½	1	3¾
	12	1	4½
6 by	6	0	9
	6½	0	9¾
	7	0	10½
	7½	0	11¼
	8	1	0
	8½	1	0¾
	9	1	1½
	9½	1	2¼
	10	1	3
	10½	1	3¾
	11	1	4½
	11½	1	5¼
	12	1	6
6½ by	6½	0	10½
	7	0	11¼
	7½	1	0
	8	1	1
	8½	1	1¾
	9	1	2½
	9½	1	3¼
	10	1	4¼
	10½	1	5
	11	1	5¾
	11½	1	6½
	12	1	7½
7 by	7	1	0¼
	7½	1	1¼
	8	1	2
	8½	1	3
	9	1	3¾
	9½	1	4¾
	10	1	5½
	10½	1	6½
	11	1	7¼
	11½	1	8¼
	12	1	9¼

In.	In.	s.	d.
7½ by	7½	1	2
	8	1	3
	8½	1	3¾
	9	1	4¾
	9½	1	5¾
	10	1	6¾
	10½	1	7½
	11	1	8½
	11½	1	9½
	12	1	10½
8 by	8	1	4
	8½	1	5
	9	1	6
	9½	1	7
	10	1	8
	10½	1	9
	11	1	10
	11½	1	11
	12	2	0
8½ by	8½	1	6
	9	1	7
	9½	1	8
	10	1	9¼
	10½	1	10¼
	11	1	11¼
	11½	2	0¼
	12	2	1½
9 by	9	1	8¼
	9½	1	9¼
	10	1	10½
	10½	1	11¾
	11	2	0¾
	11½	2	2
	12	2	3
9½ by	9½	1	10½
	10	1	11¾
	10½	2	0¾
	11	2	2
	11½	2	3¼
	12	2	4½
10 by	10	2	1
	10½	2	2¼
	11	2	3½
	11½	2	5¼
	12	2	6
10½ by	10½	2	3½
	11	2	4¾
	11½	2	6
	12	2	7½
11 by	11	2	6¼
	11½	2	7¾
	12	2	9
11½ by	11½	2	9
	12	2	10½

In.	*In.*	*s.*	*d.*
2 by	2	0	1¼
	2½	0	1½
	3	0	1¾
	3½	0	2¼
	4	0	2½
	4½	0	2¾
	5	0	3
	5½	0	3¼
	6	0	3½
	6½	0	4
	7	0	4¼
	7½	0	4½
	8	0	4¾
	8½	0	5
	9	0	5¼
	9½	0	5¾
	10	0	6
	10½	0	6¼
	11	0	6½
	11½	0	6¾
	12	0	7
2½ by	2½	0	2
	3	0	2¼
	3½	0	2¾
	4	0	3
	4½	0	3½
	5	0	3¾
	5½	0	4¼
	6	0	4½
	6½	0	5
	7	0	5¼
	7½	0	5¾
	8	0	6
	8½	0	6¼
	9	0	6¾
	9½	0	7¼
	10	0	7½
	10½	0	7¾
	11	0	8¼
	11½	0	8½
	12	0	8¾
3 by	3	0	2¾
	3½	0	3¼
	4	0	3½
	4½	0	4
	5	0	4½
	5½	0	5
	6	0	5¼
	6½	0	5¾
	7	0	6¼
	7½	0	6¾
	8	0	7
	8½	0	7½
	9	0	8
	9½	0	8¼
	10	0	8¾
	10½	0	9¼
	11	0	9¾
	11½	0	10¼
	12	0	10½

In.	*In.*	*s.*	*d.*
3½ by	3½	0	3¾
	4	0	4¼
	4½	0	4¾
	5	0	5¼
	5½	0	5¾
	6	0	6¼
	6½	0	6¾
	7	0	7¼
	7½	0	8
	8	0	8¼
	8½	0	8¾
	9	0	9½
	9½	0	10
	10	0	10¼
	10½	0	11
	11	0	11½
	11½	1	0
	12	1	0¼
4 by	4	0	4¾
	4½	0	5½
	5	0	6
	5½	0	6½
	6	0	7
	6½	0	7¾
	7	0	8¼
	7½	0	9
	8	0	9½
	8½	0	10
	9	0	10½
	9½	0	11¼
	10	0	11¾
	10½	1	0½
	11	1	1
	11½	1	1½
	12	1	2
4½ by	4½	0	6½
	5	0	7
	5½	0	7½
	6	0	8
	6½	0	8¾
	7	0	9½
	7½	0	10½
	8	0	10¾
	8½	0	11½
	9	1	0
	9½	1	1
	10	1	1¾
	10½	1	2
	11	1	2½
	11½	1	3¼
	12	1	3¾
5 by	5	0	7¾
	5½	0	8¼
	6	0	8¾
	6½	0	9¾
	7	0	10½
	7½	0	11¾
	8	1	0
	8½	1	0¾

In.	*In.*	*s.*	*d.*
5 by	9	1	1¼
	9½	1	2½
	10	1	3½
	10½	1	3¾
	11	1	4
	11½	1	5¼
	12	1	5½
5½ by	5½	0	9
	6	0	9¾
	6½	0	10¾
	7	0	11½
	7½	1	0½
	8	1	1
	8½	1	2
	9	1	2½
	9½	1	3¾
	10	1	4½
	10½	1	5¼
	11	1	5¾
	11½	1	6½
	12	1	7¼
6 by	6	0	10½
	6½	0	11½
	7	1	0¼
	7½	1	1¼
	8	1	2
	8½	1	3
	9	1	3¾
	9½	1	4¾
	10	1	5½
	10½	1	6½
	11	1	7¼
	11½	1	8¼
	12	1	9
6½ by	6½	1	0½
	7	1	1½
	7½	1	2½
	8	1	3¼
	8½	1	4¼
	9	1	5¼
	9½	1	6¼
	10	1	7
	10½	1	7½
	11	1	9
	11½	1	10
	12	1	10¾
7 by	7	1	2½
	7½	1	3½
	8	1	4½
	8½	1	5½
	9	1	6½
	9½	1	7½
	10	1	8½
	10½	1	9½
	11	1	10½
	11½	1	11½
	12	2	0½

In.	*In.*	*s.*	*d.*
7½ by	7½	1	4¾
	8	1	5¾
	8½	1	6¾
	9	1	7¾
	9½	1	9
	10	1	10
	10½	1	11¾
	11	2	0¼
	11½	2	1¼
	12	2	2¼
8 by	8	1	7
	8½	1	8
	9	1	9
	9½	1	10¼
	10	1	11½
	10½	2	0¾
	11	2	1¾
	11½	2	3
	12	2	4
8½ by	8½	1	9
	9	1	10¼
	9½	1	11¾
	10	2	1
	10½	2	2¼
	11	2	3½
	11½	2	4¾
	12	2	5¾
9 by	9	1	11½
	9½	2	1
	10	2	2½
	10½	2	3¾
	11	2	5
	11½	2	6¼
	12	2	7¼
9½ by	9½	2	3
	10	2	4½
	10½	2	5¾
	11	2	6½
	11½	2	8
	12	2	9¼
10 by	10	2	7
	10½	2	7½
	11	2	8
	11½	2	9½
	12	2	11
10½ by	10½	2	8¼
	11	2	9¾
	11½	2	11¾
	12	3	0¾
11 by	11	2	11¼
	11½	3	2
	12	3	2½
11½ by	11½	3	2¼
	12	3	4

In.	*In.*	*s.*	*d.*
2 by	2	0	1½
	2½	0	1¾
	3	0	2
	3½	0	2½
	4	0	2¾
	4½	0	3
	5	0	3½
	5½	0	3¾
	6	0	4
	6½	0	4½
	7	0	4¾
	7½	0	5
	8	0	5½
	8½	0	5¾
	9	0	6
	9½	0	6½
	10	0	6¾
	10½	0	7
	11	0	7¼
	11½	0	7¾
	12	0	8
2½ by	2½	0	2¼
	3	0	2½
	3½	0	3
	4	0	3½
	4½	0	3¾
	5	0	4¼
	5½	0	4¾
	6	0	5
	6½	0	5½
	7	0	6
	7½	0	6¼
	8	0	6¾
	8½	0	7¼
	9	0	7½
	9½	0	8
	10	0	8½
	10½	0	8¾
	11	0	9¼
	11½	0	9¾
	12	0	10
3 by	3	0	3
	3½	0	3½
	4	0	4
	4½	0	4½
	5	0	5
	5½	0	5½
	6	0	6
	6½	0	6½
	7	0	7
	7½	0	7½
	8	0	8
	8½	0	8½
	9	0	9
	9½	0	9½
	10	0	10
	10½	0	10½
	11	0	11
	11½	0	11½
	12	1	0

In.	*In.*	*s.*	*d.*
3½ by	3½	0	4¼
	4	0	4¾
	4½	0	5½
	5	0	6
	5½	0	6½
	6	0	7
	6½	0	7¾
	7	0	8¼
	7½	0	9
	8	0	9½
	8½	0	10
	9	0	10½
	9½	0	11¼
	10	0	11¾
	10½	1	0½
	11	1	1
	11½	1	1½
	12	1	2
4 by	4	0	5½
	4½	0	6¼
	5	0	6¾
	5½	0	7½
	6	0	8
	6½	0	8¾
	7	0	9½
	7½	0	10¼
	8	0	10¾
	8½	0	11½
	9	1	0
	9½	1	0¾
	10	1	1½
	10½	1	2¼
	11	1	2¾
	11½	1	3½
	12	1	4
4½ by	4½	0	7
	5	0	7¾
	5½	0	8½
	6	0	9
	6½	0	10
	7	0	10¾
	7½	0	11
	8	0	11¾
	8½	1	1
	9	1	1½
	9½	1	2½
	10	1	3¼
	10½	1	4
	11	1	4½
	11½	1	5¼
	12	1	6
5 by	5	0	8¾
	5½	0	9½
	6	0	10
	6½	0	11
	7	1	0
	7½	1	0¾
	8	1	1½
	8½	1	2¼

In.	*In.*	*s.*	*d.*
5 by	9	1	3
	9½	1	4¼
	10	1	4¾
	10½	1	5½
	11	1	6¼
	11½	1	7
	12	1	8
5½ by	5½	0	10
	6	0	11
	6½	1	0
	7	1	1
	7½	1	2
	8	1	2¾
	8½	1	3¾
	9	1	4½
	9½	1	5¾
	10	1	7
	10½	1	7¼
	11	1	8¼
	11½	1	9
	12	1	10
6 by	6	1	0
	6½	1	1
	7	1	2
	7½	1	3
	8	1	4
	8½	1	5
	9	1	6
	9½	1	7
	10	1	8
	10½	1	9
	11	1	10
	11½	1	11
	12	2	0
6½ by	6½	1	1¾
	7	1	3¼
	7½	1	4½
	8	1	5½
	8½	1	6¾
	9	1	7¾
	9½	1	8¾
	10	1	9¾
	10½	1	11
	11	2	0
	11½	2	1
	12	2	2
7 by	7	1	4½
	7½	1	5¾
	8	1	7
	8½	1	8¼
	9	1	9¼
	9½	1	10½
	10	1	11½
	10½	2	0¾
	11	2	1¾
	11½	2	3
	12	2	4

In.	*In.*	*s.*	*d.*
7½ by	7½	1	7½
	8	1	8½
	8½	1	9½
	9	1	10¾
	9½	2	0
	10	2	1¼
	10½	2	2½
	11	2	3½
	11½	2	5
	12	2	6
8 by	8	1	9½
	8½	1	10¾
	9	2	0
	9½	2	1½
	10	2	2¾
	10½	2	4
	11	2	5¼
	11½	2	6¾
	12	2	8
8½ by	8½	2	1½
	9	2	2¼
	9½	2	3
	10	2	4½
	10½	2	5¾
	11	2	7½
	11½	2	8¾
	12	2	10
9 by	9	2	2¾
	9½	2	4½
	10	2	6
	10½	2	7½
	11	2	9
	11½	2	10½
	12	3	0
9½ by	9½	2	7¼
	10	2	8½
	10½	2	9¾
	11	2	11
	11½	3	0½
	12	3	2
10 by	10	2	11
	10½	3	0
	11	3	0¾
	11½	3	2½
	12	3	4
10½ by	10½	3	0½
	11	3	2½
	11½	3	4½
	12	3	6
11 by	11	3	4¼
	11½	3	6¼
	12	3	8
11½ by	11½	3	8
	12	3	10

In.	In.	s.	d.
2 by	2	0	1½
	2½	0	2
	3	0	2¼
	3½	0	2¾
	4	0	3
	4½	0	3½
	5	0	4
	5½	0	4¼
	6	0	4½
	6½	0	5
	7	0	5¼
	7½	0	5¾
	8	0	6
	8½	0	6½
	9	0	6¾
	9½	0	7¼
	10	0	7½
	10½	0	7¾
	11	0	8¼
	11½	0	8¾
	12	0	9
2½ by	2½	0	2½
	3	0	3
	3½	0	3½
	4	0	3¾
	4½	0	4½
	5	0	5
	5½	0	5¼
	6	0	5½
	6½	0	6¼
	7	0	7
	7½	0	7¼
	8	0	7½
	8½	0	8¼
	9	0	8½
	9½	0	9
	10	0	9½
	10½	0	10
	11	0	10½
	11½	0	11
	12	0	11¼
3 by	3	0	3½
	3½	0	4
	4	0	4½
	4½	0	5¼
	5	0	5¾
	5½	0	6¼
	6	0	6¾
	6½	0	7½
	7	0	8
	7½	0	8½
	8	0	9
	8½	0	9¾
	9	0	10¼
	9½	0	10¾
	10	0	11¼
	10½	1	0
	11	1	0½
	11½	1	1
	12	1	1½

In.	In.	s.	d.
3½ by	3½	0	4¾
	4	0	5¼
	4½	0	5¾
	5	0	6¾
	5½	0	7¼
	6	0	8
	6½	0	8¾
	7	0	9¼
	7½	0	10
	8	0	10½
	8½	0	11¼
	9	1	0
	9½	1	0½
	10	1	1¼
	10½	1	1¾
	11	1	2¼
	11½	1	3
	12	1	3¾
4 by	4	0	6
	4½	0	6¾
	5	0	7½
	5½	0	8¼
	6	0	9
	6½	0	9¾
	7	0	10½
	7½	0	11¼
	8	1	0
	8½	1	0½
	9	1	1½
	9½	1	2¼
	10	1	3
	10½	1	3½
	11	1	4
	11½	1	5
	12	1	6
4½ by	4½	0	8
	5	0	8¾
	5½	0	9½
	6	0	10¼
	6½	0	11¼
	7	1	0
	7½	1	1¼
	8	1	2¼
	8½	1	2¾
	9	1	3¼
	9½	1	4½
	10	1	5½
	10½	1	6
	11	1	7
	11½	1	7½
	12	1	8¼
5 by	5	0	10
	5½	0	10¾
	6	0	11¼
	6½	1	0½
	7	1	1½
	7½	1	3
	8	1	4¼
	8½	1	4¾

In.	In.	s.	d.
5 by	9	1	5
	9½	1	6½
	10	1	7¼
	10½	1	8¼
	11	1	8¾
	11½	1	9¾
	12	1	10½
5½ by	5½	1	0
	6	1	0½
	6½	1	1
	7	1	2¾
	7½	1	4
	8	1	5¼
	8½	1	6
	9	1	6¾
	9½	1	8
	10	1	9¼
	10½	1	10
	11	1	10¾
	11½	2	0
	12	2	0¾
6 by	6	1	1½
	6½	1	2¾
	7	1	3¾
	7½	1	5
	8	1	6
	8½	1	7¼
	9	1	8¼
	9½	1	9½
	10	1	10½
	10½	1	11¾
	11	2	0¾
	11½	2	2
	12	2	3
6½ by	6½	1	4
	7	1	5¼
	7½	1	6½
	8	1	7¾
	8½	1	9
	9	1	10
	9½	1	11½
	10	2	0½
	10½	2	1¾
	11	2	3
	11½	2	4¼
	12	2	5¼
7 by	7	1	6½
	7½	1	8
	8	1	9½
	8½	1	10½
	9	1	11¾
	9½	2	1¼
	10	2	2½
	10½	2	3¾
	11	2	5
	11½	2	6¼
	12	2	7½

In.	In.	s.	d.
7½ by	7½	1	9½
	8	1	10¾
	8½	2	0
	9	2	1½
	9½	2	3
	10	2	4¼
	10½	2	5¾
	11	2	7
	11½	2	8½
	12	2	9¾
8 by	8	2	0
	8½	2	1½
	9	2	3
	9½	2	4½
	10	2	6
	10½	2	7½
	11	2	9
	11½	2	10½
	12	3	0
8½ by	8½	2	3½
	9	2	4½
	9½	2	6¼
	10	2	8
	10½	2	9¾
	11	2	11½
	11½	3	0¾
	12	3	2¼
9 by	9	2	6
	9½	2	8
	10	2	10
	10½	2	11¾
	11	3	1¼
	11½	3	3
	12	3	4½
9½ by	9½	2	10
	10	2	11¾
	10½	3	1½
	11	3	3½
	11½	3	5
	12	3	6¾
10 by	10	3	3½
	10½	3	4¼
	11	3	5
	11½	3	7
	12	3	9
10½ by	10½	3	7¼
	11	3	8¼
	11½	3	9¼
	12	3	11¼
11 by	11	3	9½
	11½	3	11[illegible]
	12	4	1½
11½ by	11½	4	1[illegible]
	12	4	3[illegible]

In.	In.	s.	d.
2 by	2	0	1¾
	2½	0	2¼
	3	0	2½
	3½	0	3
	4	0	3½
	4½	0	3¾
	5	0	4¼
	5½	0	4¾
	6	0	5
	6½	0	5½
	7	0	6
	7½	0	6¼
	8	0	6¾
	8½	0	7¼
	9	0	7½
	9½	0	8
	10	0	8½
	10½	0	9
	11	0	9¼
	11½	0	9¾
	12	0	10
2½ by	2½	0	2¾
	3	0	3¼
	3½	0	3¾
	4	0	4¼
	4½	0	4¾
	5	0	5½
	5½	0	5¾
	6	0	6½
	6½	0	7
	7	0	7½
	7½	0	8
	8	0	8½
	8½	0	9
	9	0	9½
	9½	0	10
	10	0	10½
	10½	0	11¼
	11	0	11½
	11½	1	0¼
	12	1	0½
3 by	3	0	3¾
	3½	0	4½
	4	0	5
	4½	0	5¾
	5	0	6¼
	5½	0	7
	6	0	7½
	6½	0	8¼
	7	0	8¾
	7½	0	9½
	8	0	10
	8½	0	10¾
	9	0	11¼
	9½	1	0
	10	1	0½
	10½	1	1¼
	11	1	1¾
	11½	1	2½
	12	1	3
3½ by	3½	0	5
	4	0	6
	4½	0	7
	5	0	7½
	5½	0	8¼
	6	0	8¾
	6½	0	9¾
	7	0	10½
	7½	0	11¼
	8	1	0¼
	8½	1	1
	9	1	1¼
	9½	1	2
	10	1	2¾
	10½	1	3½
	11	1	4
	11½	1	5
	12	1	5½
4 by	4	0	6¾
	4½	0	7¾
	5	0	8½
	5½	0	9¼
	6	0	10
	6½	0	11
	7	0	11¾
	7½	1	0¾
	8	1	1½
	8½	1	2¼
	9	1	3
	9½	1	4
	10	1	4¾
	10½	1	5½
	11	1	6¼
	11½	1	7¼
	12	1	8
4½ by	4½	0	9
	5	0	9¾
	5½	0	10½
	6	0	11½
	6½	1	0½
	7	1	1½
	7½	1	2½
	8	1	3¼
	8½	1	4¼
	9	1	5
	9½	1	6
	10	1	7
	10½	1	7¾
	11	1	8½
	11½	1	9¾
	12	1	10½
5 by	5	0	11
	5½	0	11¾
	6	1	0½
	6½	1	1¾
	7	1	3
	7½	1	4
	8	1	5
	8½	1	6
5 by	9	1	6¾
	9½	1	7¾
	10	1	9
	10½	1	9¾
	11	1	10¾
	11½	2	0
	12	2	1
5½ by	5½	1	0½
	6	1	1¾
	6½	1	3
	7	1	4¼
	7½	1	5½
	8	1	6½
	8½	1	7¼
	9	1	8¾
	9½	1	10
	10	1	11
	10½	2	0
	11	2	1¼
	11½	2	2½
	12	2	3½
6 by	6	1	3
	6½	1	4¼
	7	1	5½
	7½	1	6¾
	8	1	8
	8½	1	9¼
	9	1	10½
	9½	1	11¾
	10	2	1
	10½	2	2¼
	11	2	3½
	11½	2	4¾
	12	2	6
6½ by	6½	1	5½
	7	1	7
	7½	1	8½
	8	1	9¾
	8½	1	11¾
	9	2	0½
	9½	2	2
	10	2	3¼
	10½	2	4½
	11	2	5¾
	11½	2	7¼
	12	2	8½
7 by	7	1	8½
	7½	1	10
	8	1	11½
	8½	2	2
	9	2	2¼
	9½	2	3¾
	10	2	5¼
	10½	2	6½
	11	2	8
	11½	2	9½
	12	2	11
7½ by	7½	2	0
	8	2	1½
	8½	2	3¼
	9	2	4¼
	9½	2	5¾
	10	2	7¼
	10½	2	8¾
	11	2	10½
	11½	3	0
	12	3	2
8 by	8	2	3
	8½	2	4½
	9	2	6
	9½	2	7½
	10	2	9
	10½	2	11
	11	3	0¾
	11½	3	2½
	12	3	4
8½ by	8½	2	5½
	9	2	7½
	9½	2	9½
	10	2	11¼
	10½	3	1¼
	11	3	3¼
	11½	3	5
	12	3	7
9 by	9	2	9
	9½	2	11¼
	10	3	1½
	10½	3	3½
	11	3	5¼
	11½	3	7¼
	12	3	9
9½ by	9½	3	2½
	10	3	4¾
	10½	3	6¼
	11	3	7½
	11½	3	9¾
	12	3	11½
10 by	10	3	8
	10½	3	9
	11	3	9¾
	11½	4	0
	12	4	2
10½ by	10½	3	9¾
	11	4	0¼
	11½	4	2½
	12	4	4½
11 by	11	4	2½
	11½	4	4¾
	12	4	7
11½ by	11½	4	7
	12	4	9½

TABLE IV.

SUPERFICIAL MEASURE.

By this Table the superficial contents, and consequently the value, of any quantity of board, glass, &c., may be found, AT SIGHT, from 1 inch to 24 inches, the breadth, and from $\frac{1}{4}$ of an inch to 24 feet, the length; and therefore, by addition only, may serve to any greater breadth or length, if there should ever be occasion.

Each page of this Table is divided into three distinct parts; and each part consists of four columns. The first part of the narrow column to the left-hand shows the several lengths in feet, from 1 to 24; the second part the odd inches, from 1 to 11; and the third part, the odd quarters of an inch. The three or four figures in the larger column on the right-hand, marked at the top Ft. In. Pa., and lower Ft. In. Pa. S. T., are the several contents in square feet, twelfths of a square foot, square inches, seconds, and thirds, answering to the length in the left-hand column.

Example I.—A board is 5 inches broad and 9 feet long, to find how many square feet it contains; look at the top of the Table for 5 in., and then keep the eye down the left-hand column until you come to 9 ft., over against which stands 3 ft. 9 in. 0 pa.

Example II.—To find the square feet in a plank 17 ft. 9 in. long, and 21½ in. broad. At the top of the Table find 21½ in., and then look down the left-hand column for 17 ft., against which stands 30 ft. 5 in. 6 pa. Then look for 9 in., against which stands 1 ft. 4 in. 1 pa. 6 s.; add the two together, and the content is found to be 31 ft. 9 in. 7 pa. The quarters of an inch (when you have occasion for them) must be found, and added to the feet and inches. If a plank is broader at one end than the other, either take the breadth at the middle, or at each end, and add them together, and take the half sum for the true breadth (provided both edges are straight).

Example III.—To find the area of a plank broader than 24 in.—say 27 in.—and 19 ft. long, proceed thus:—

	ft.	in.	pa.
19 ft. long, and 24 in. broad, is . .	38	0	0
Ditto 3 ditto . . .	4	9	0
Content required is . .	42	9	0

Example IV.—To find how many feet of glass are contained in a sash-window having 18 squares, each square being 20 in. high, and 11¾ in. broad. First, add together the height of the 18 squares, which is 360 in., or 30 ft.; then look in the Table for 11¾ in.; but, since it does not extend to 30 ft., take the answer out at twice; thus:—

	ft.	in.	pa.
20 ft. long, and 11¾ in. in breadth is .	19	7	0
10 ft. ditto ditto ditto .	9	9	6
Content required is . .	29	4	6

Ft. long	*1 in. broad.* Ft.	In.	Pa.	*Ft. long*	*1¼ in. broad.* Ft.	In.	Pa.	*Ft. long*	*1½ in. broad.* Ft.	In.	Pa.	*Ft. long*	*1¾ in. broad.* Ft.	In.	Pa.
1	0	1	0	1	0	1	3	1	0	1	6	1	0	1	9
2	0	2	0	2	0	2	6	2	0	3	0	2	0	3	6
3	0	3	0	3	0	3	9	3	0	4	6	3	0	5	3
4	0	4	0	4	0	5	0	4	0	6	0	4	0	7	0
5	0	5	0	5	0	6	3	5	0	7	6	5	0	8	9
6	0	6	0	6	0	7	6	6	0	9	0	6	0	10	6
7	0	7	0	7	0	8	9	7	0	10	6	7	1	0	3
8	0	8	0	8	0	10	0	8	1	0	0	8	1	2	0
9	0	9	0	9	0	11	3	9	1	1	6	9	1	3	9
10	0	10	0	10	1	0	6	10	1	3	0	10	1	5	6
11	0	11	0	11	1	1	9	11	1	4	6	11	1	7	3
12	1	0	0	12	1	3	0	12	1	6	0	12	1	9	0
13	1	1	0	13	1	4	3	13	1	7	6	13	1	10	9
14	1	2	0	14	1	5	6	14	1	9	0	14	2	0	6
15	1	3	0	15	1	6	9	15	1	10	6	15	2	2	3
16	1	4	0	16	1	8	0	16	2	0	0	16	2	4	0
17	1	5	0	17	1	9	3	17	2	1	6	17	2	5	9
18	1	6	0	18	1	10	6	18	2	3	0	18	2	7	6
19	1	7	0	19	1	11	9	19	2	4	6	19	2	9	3
20	1	8	0	20	2	1	0	20	2	6	0	20	2	11	0
21	1	9	0	21	2	2	3	21	2	7	6	21	3	0	9
22	1	10	0	22	2	3	6	22	2	9	0	22	3	2	6
23	1	11	0	23	2	4	9	23	2	10	6	23	3	4	3
24	2	0	0	24	2	6	0	24	3	0	0	24	3	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	1	0	1	0	0	1	3	1	0	0	1	6	1	0	0	1	9
2	0	0	2	0	2	0	0	2	6	2	0	0	3	0	2	0	0	3	6
3	0	0	3	0	3	0	0	3	9	3	0	0	4	6	3	0	0	5	3
4	0	0	4	0	4	0	0	5	0	4	0	0	6	0	4	0	0	7	0
5	0	0	5	0	5	0	0	6	3	5	0	0	7	6	5	0	0	8	9
6	0	0	6	0	6	0	0	7	6	6	0	0	9	0	6	0	0	10	6
7	0	0	7	0	7	0	0	8	9	7	0	0	10	6	7	0	1	0	3
8	0	0	8	0	8	0	0	10	0	8	0	1	0	0	8	0	1	2	0
9	0	0	9	0	9	0	0	11	3	9	0	1	1	6	9	0	1	3	9
10	0	0	10	0	10	0	1	0	6	10	0	1	3	0	10	0	1	5	6
11	0	0	11	0	11	0	1	1	9	11	0	1	4	6	11	0	1	7	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	0	3	0	¼	0	0	3	9	¼	0	0	4	6	¼	0	0	5	3
½	0	0	6	0	½	0	0	7	6	½	0	0	9	0	½	0	0	10	6
¾	0	0	9	0	¾	0	0	11	3	¾	0	1	1	6	¾	0	1	3	9

Ft. long	*2 in. broad.*			*Ft. long*	*2¼ in. broad.*			*Ft. long*	*2½ in. broad.*			*Ft. long*	*2¾ in. broad.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	2	0	1	0	2	3	1	0	2	6	1	0	2	9
2	0	4	0	2	0	4	6	2	0	5	0	2	0	5	6
3	0	6	0	3	0	6	9	3	0	7	6	3	0	8	3
4	0	8	0	4	0	9	0	4	0	10	0	4	0	11	0
5	0	10	0	5	0	11	3	5	1	0	6	5	1	1	9
6	1	0	0	6	1	1	6	6	1	3	0	6	1	4	6
7	1	2	0	7	1	3	9	7	1	5	6	7	1	7	3
8	1	4	0	8	1	6	0	8	1	8	0	8	1	10	0
9	1	6	0	9	1	8	3	9	1	10	6	9	2	0	9
10	1	8	0	10	1	10	6	10	2	1	0	10	2	3	6
11	1	10	0	11	2	0	9	11	2	3	6	11	2	6	3
12	2	0	0	12	2	3	0	12	2	6	0	12	2	9	0
13	2	2	0	13	2	5	3	13	2	8	6	13	2	11	9
14	2	4	0	14	2	7	6	14	2	11	0	14	3	2	6
15	2	6	0	15	2	9	9	15	3	1	6	15	3	5	3
16	2	8	0	16	3	0	0	16	3	4	0	16	3	8	0
17	2	10	0	17	3	2	3	17	3	6	6	17	3	10	9
18	3	0	0	18	3	4	6	18	3	9	0	18	4	1	6
19	3	2	0	19	3	6	9	19	3	11	6	19	4	4	3
20	3	4	0	20	3	9	0	20	4	2	0	20	4	7	0
21	3	6	0	21	3	11	3	21	4	4	6	21	4	9	9
22	3	8	0	22	4	1	6	22	4	7	0	22	5	0	6
23	3	10	0	23	4	3	9	23	4	9	6	23	5	3	3
24	4	0	0	24	4	6	0	24	5	0	0	24	5	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	2	0	1	0	0	2	3	1	0	0	2	6	1	0	0	2	9
2	0	0	4	0	2	0	0	4	6	2	0	0	5	0	2	0	0	5	6
3	0	0	6	0	3	0	0	6	9	3	0	0	7	6	3	0	0	8	3
4	0	0	8	0	4	0	0	9	0	4	0	0	10	0	4	0	0	11	0
5	0	0	10	0	5	0	0	11	3	5	0	1	0	6	5	0	1	1	9
6	0	1	0	0	6	0	1	1	6	6	0	1	3	0	6	0	1	4	6
7	0	1	2	0	7	0	1	3	9	7	0	1	5	6	7	0	1	7	3
8	0	1	4	0	8	0	1	6	0	8	0	1	8	0	8	0	1	10	0
9	0	1	6	0	9	0	1	8	3	9	0	1	10	6	9	0	2	0	9
10	0	1	8	0	10	0	1	10	6	10	0	2	1	0	10	0	2	3	6
11	0	1	10	0	11	0	2	0	9	11	0	2	3	6	11	0	2	6	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	0	6	0	¼	0	0	6	9	¼	0	0	7	6	¼	0	0	8	3
½	0	1	0	0	½	0	1	1	6	½	0	1	3	0	½	0	1	4	6
¾	0	1	6	0	¾	0	1	8	3	¾	0	1	10	6	¾	0	2	0	9

Ft. long	*3 in. broad.*			*Ft. long*	*3¼ in. broad.*			*Ft. long*	*3½ in. broad.*			*Ft. long*	*3¾ in. broad.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	3	0	1	0	3	3	1	0	3	6	1	0	3	9
2	0	6	0	2	0	6	6	2	0	7	0	2	0	7	6
3	0	9	0	3	0	9	9	3	0	10	6	3	0	11	3
4	1	0	0	4	1	1	0	4	1	2	0	4	1	3	0
5	1	3	0	5	1	4	3	5	1	5	6	5	1	6	9
6	1	6	0	6	1	7	6	6	1	9	0	6	1	10	6
7	1	9	0	7	1	10	9	7	2	0	6	7	2	2	3
8	2	0	0	8	2	2	0	8	2	4	0	8	2	6	0
9	2	3	0	9	2	5	3	9	2	7	6	9	2	9	9
10	2	6	0	10	2	8	6	10	2	11	0	10	3	1	6
11	2	9	0	11	2	11	9	11	3	2	6	11	3	5	3
12	3	0	0	12	3	3	0	12	3	6	0	12	3	9	0
13	3	3	0	13	3	6	3	13	3	9	6	13	4	0	9
14	3	6	0	14	3	9	6	14	4	1	0	14	4	4	6
15	3	9	0	15	4	0	9	15	4	4	6	15	4	8	3
16	4	0	0	16	4	4	0	16	4	8	0	16	5	0	0
17	4	3	0	17	4	7	3	17	4	11	6	17	5	3	9
18	4	6	0	18	4	10	6	18	5	3	0	18	5	7	6
19	4	9	0	19	5	1	9	19	5	6	6	19	5	11	3
20	5	0	0	20	5	5	0	20	5	10	0	20	6	3	0
21	5	3	0	21	5	8	3	21	6	1	6	21	6	6	9
22	5	6	0	22	5	11	6	22	6	5	0	22	6	10	6
23	5	9	0	23	6	2	9	23	6	8	6	23	7	2	3
24	6	0	0	24	6	6	0	24	7	0	0	24	7	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	3	0	1	0	0	3	3	1	0	0	3	6	1	0	0	3	9
2	0	0	6	0	2	0	0	6	6	2	0	0	7	0	2	0	0	7	6
3	0	0	9	0	3	0	0	9	9	3	0	0	10	6	3	0	0	11	3
4	0	1	0	0	4	0	1	1	0	4	0	1	2	0	4	0	1	3	0
5	0	1	3	0	5	0	1	4	3	5	0	1	5	6	5	0	1	6	9
6	0	1	6	0	6	0	1	7	6	6	0	1	9	0	6	0	1	10	6
7	0	1	9	0	7	0	1	10	9	7	0	2	0	6	7	0	2	2	3
8	0	2	0	0	8	0	2	2	0	8	0	2	4	0	8	0	2	6	0
9	0	2	3	0	9	0	2	5	3	9	0	2	7	6	9	0	2	9	9
10	0	2	6	0	10	0	2	8	6	10	0	2	11	0	10	0	3	1	6
11	0	2	9	0	11	0	2	11	9	11	0	3	2	6	11	0	3	5	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	0	9	0	¼	0	0	9	9	¼	0	0	10	6	¼	0	0	11	3
½	0	1	6	0	½	0	1	7	6	½	0	1	9	0	½	0	1	10	6
¾	0	2	3	0	¾	0	2	5	3	¾	0	2	7	6	¾	0	2	9	9

Ft. long	*4 in. broad.* Ft.	In.	Pa.	*Ft. long*	*4¼ in. broad.* Ft.	In.	Pa.	*Ft. long*	*4½ in. broad.* Ft.	In.	Pa.	*Ft. long*	*4¾ in. broad.* Ft.	In.	Pa.
1	0	4	0	1	0	4	3	1	0	4	6	1	0	4	9
2	0	8	0	2	0	8	6	2	0	9	0	2	0	9	6
3	1	0	0	3	1	0	9	3	1	1	6	3	1	2	3
4	1	4	0	4	1	5	0	4	1	6	0	4	1	7	0
5	1	8	0	5	1	9	3	5	1	10	6	5	1	11	9
6	2	0	0	6	2	1	6	6	2	3	0	6	2	4	6
7	2	4	0	7	2	5	9	7	2	7	6	7	2	9	3
8	2	8	0	8	2	10	0	8	3	0	0	8	3	2	0
9	3	0	0	9	3	2	3	9	3	4	6	9	3	6	9
10	3	4	0	10	3	6	6	10	3	9	0	10	3	11	6
11	3	8	0	11	3	10	9	11	4	1	6	11	4	4	3
12	4	0	0	12	4	3	0	12	4	6	0	12	4	9	0
13	4	4	0	13	4	7	3	13	4	10	6	13	5	1	9
14	4	8	0	14	4	11	6	14	5	3	0	14	5	6	6
15	5	0	0	15	5	3	9	15	5	7	6	15	5	11	3
16	5	4	0	16	5	8	0	16	6	0	0	16	6	4	0
17	5	8	0	17	6	0	3	17	6	4	6	17	6	8	9
18	6	0	0	18	6	4	6	18	6	9	0	18	7	1	6
19	6	4	0	19	6	8	9	19	7	1	6	19	7	6	3
20	6	8	0	20	7	1	0	20	7	6	0	20	7	11	0
21	7	0	0	21	7	5	3	21	7	10	6	21	8	3	9
22	7	4	0	22	7	9	6	22	8	3	0	22	8	8	6
23	7	8	0	23	8	1	9	23	8	7	6	23	9	1	3
24	8	0	0	24	8	6	0	24	9	0	0	24	9	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	4	0	1	0	0	4	3	1	0	0	4	6	1	0	0	4	9
2	0	0	8	0	2	0	0	8	6	2	0	0	9	0	2	0	0	9	6
3	0	1	0	0	3	0	1	0	9	3	0	1	1	6	3	0	1	2	3
4	0	1	4	0	4	0	1	5	0	4	0	1	6	0	4	0	1	7	0
5	0	1	8	0	5	0	1	9	3	5	0	1	10	6	5	0	1	11	9
6	0	2	0	0	6	0	2	1	6	6	0	2	3	0	6	0	2	4	6
7	0	2	4	0	7	0	2	5	9	7	0	2	7	6	7	0	2	9	3
8	0	2	8	0	8	0	2	10	0	8	0	3	0	0	8	0	3	2	0
9	0	3	0	0	9	0	3	2	3	9	0	3	4	6	9	0	3	6	9
10	0	3	4	0	10	0	3	6	6	10	0	3	9	0	10	0	3	11	6
11	0	3	8	0	11	0	3	10	9	11	0	4	1	6	11	0	4	4	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	1	0	0	¼	0	1	0	9	¼	0	1	1	6	¼	0	1	2	3
½	0	2	0	0	½	0	2	1	6	½	0	2	3	0	½	0	2	4	6
¾	0	3	0	0	¾	0	3	2	3	¾	0	3	4	6	¾	0	3	6	9

Ft. long	5 in. broad			Ft. long	5¼ in. broad			Ft. long	5½ in. broad			Ft. long	5¾ in. broad		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	5	0	1	0	5	3	1	0	5	6	1	0	5	9
2	0	10	0	2	0	10	6	2	0	11	0	2	0	11	6
3	1	3	0	3	1	3	9	3	1	4	6	3	1	5	3
4	1	8	0	4	1	9	0	4	1	10	0	4	1	11	0
5	2	1	0	5	2	2	3	5	2	3	6	5	2	4	9
6	2	6	0	6	2	7	6	6	2	9	0	6	2	10	6
7	2	11	0	7	3	0	9	7	3	2	6	7	3	4	3
8	3	4	0	8	3	6	0	8	3	8	0	8	3	10	0
9	3	9	0	9	3	11	3	9	4	1	6	9	4	3	9
10	4	2	0	10	4	4	6	10	4	7	0	10	4	9	6
11	4	7	0	11	4	9	9	11	5	0	6	11	5	3	3
12	5	0	0	12	5	3	0	12	5	6	0	12	5	9	0
13	5	5	0	13	5	8	3	13	5	11	6	13	6	2	9
14	5	10	0	14	6	1	6	14	6	5	0	14	6	8	6
15	6	3	0	15	6	6	9	15	6	10	6	15	7	2	3
16	6	8	0	16	7	0	0	16	7	4	0	16	7	8	0
17	7	1	0	17	7	5	3	17	7	9	6	17	8	1	9
18	7	6	0	18	7	10	6	18	8	3	0	18	8	7	6
19	7	11	0	19	8	3	9	19	8	8	6	19	9	1	3
20	8	4	0	20	8	9	0	20	9	2	0	20	9	7	0
21	8	9	0	21	9	2	3	21	9	7	6	21	10	0	9
22	9	2	0	22	9	7	6	22	10	1	0	22	10	6	6
23	9	7	0	23	10	0	9	23	10	6	6	23	11	2	3
24	10	0	0	24	10	6	0	24	11	0	0	24	11	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	0	5	0	1	0	0	5	3	1	0	0	5	6	1	0	0	5	9
2	0	0	10	0	2	0	0	10	6	2	0	0	11	0	2	0	0	11	6
3	0	1	3	0	3	0	1	3	9	3	0	1	4	6	3	0	1	5	3
4	0	1	8	0	4	0	1	9	0	4	0	1	10	0	4	0	1	11	0
5	0	2	1	0	5	0	2	2	3	5	0	2	3	6	5	0	2	4	9
6	0	2	6	0	6	0	2	7	6	6	0	2	9	0	6	0	2	10	6
7	0	2	11	0	7	0	3	0	9	7	0	3	2	6	7	0	3	4	3
8	0	3	4	0	8	0	3	6	0	8	0	3	8	0	8	0	3	10	0
9	0	3	9	0	9	0	3	11	3	9	0	4	1	6	9	0	4	3	9
10	0	4	2	0	10	0	4	4	6	10	0	4	7	0	10	0	4	9	6
11	0	4	7	0	11	0	4	9	9	11	0	5	0	6	11	0	5	3	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	1	3	0	¼	0	1	3	9	¼	0	1	4	6	¼	0	1	5	3
½	0	2	6	0	½	0	2	7	6	½	0	2	9	0	½	0	2	10	6
¾	0	3	9	0	¾	0	3	11	3	¾	0	4	1	6	¾	0	4	3	9

Ft. long	6 in. broad.			Ft. long	6¼ in. broad.			Ft. long	6½ in. broad.			Ft. long	6¾ in. broad.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	6	0	1	0	6	3	1	0	6	6	1	0	6	9
2	1	0	0	2	1	0	6	2	1	1	0	2	1	1	6
3	1	6	0	3	1	6	9	3	1	7	6	3	1	8	3
4	2	0	0	4	2	1	0	4	2	2	0	4	2	3	0
5	2	6	0	5	2	7	3	5	2	8	6	5	2	9	9
6	3	0	0	6	3	1	6	6	3	3	0	6	3	4	6
7	3	6	0	7	3	7	9	7	3	9	6	7	3	11	3
8	4	0	0	8	4	2	0	8	4	4	0	8	4	6	0
9	4	6	0	9	4	8	3	9	4	10	6	9	5	0	9
10	5	0	0	10	5	2	6	10	5	5	0	10	5	7	6
11	5	6	0	11	5	8	9	11	5	11	6	11	6	2	3
12	6	0	0	12	6	3	0	12	6	6	0	12	6	9	0
13	6	6	0	13	6	9	3	13	7	0	6	13	7	3	9
14	7	0	0	14	7	3	6	14	7	7	0	14	7	10	6
15	7	6	0	15	7	9	9	15	8	1	6	15	8	5	3
16	8	0	0	16	8	4	0	16	8	8	0	16	9	0	0
17	8	6	0	17	8	10	3	17	9	2	6	17	9	6	9
18	9	0	0	18	9	4	6	18	9	9	0	18	10	1	6
19	9	6	0	19	9	10	9	19	10	3	6	19	10	8	3
20	10	0	0	20	10	5	0	20	10	10	0	20	11	3	0
21	10	6	0	21	10	11	3	21	11	4	6	21	11	9	9
22	11	0	0	22	11	5	6	22	11	11	0	22	12	4	6
23	11	6	0	23	11	11	9	23	12	5	6	23	12	11	3
24	12	0	0	24	12	6	0	24	13	0	0	24	13	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	0	6	0	1	0	0	6	3	1	0	0	6	6	1	0	0	6	9
2	0	1	0	0	2	0	1	0	6	2	0	1	1	0	2	0	1	1	6
3	0	1	6	0	3	0	1	6	9	3	0	1	7	6	3	0	1	8	3
4	0	2	0	0	4	0	2	1	0	4	0	2	2	0	4	0	2	3	0
5	0	2	6	0	5	0	2	7	3	5	0	2	8	6	5	0	2	9	9
6	0	3	0	0	6	0	3	1	6	6	0	3	3	0	6	0	3	4	6
7	0	3	6	0	7	0	3	7	9	7	0	3	9	6	7	0	3	11	3
8	0	4	0	0	8	0	4	2	0	8	0	4	4	0	8	0	4	6	0
9	0	4	6	0	9	0	4	8	3	9	0	4	10	6	9	0	5	0	9
10	0	5	0	0	10	0	5	2	6	10	0	5	5	0	10	0	5	7	6
11	0	5	6	0	11	0	5	8	9	11	0	5	11	6	11	0	6	2	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	1	6	0	¼	0	1	6	9	¼	0	1	7	6	¼	0	1	8	3
½	0	3	0	0	½	0	3	1	6	½	0	3	3	0	½	0	3	4	6
¾	0	4	6	0	¾	0	4	8	3	¾	0	4	10	6	¾	0	5	0	9

Ft. long	*7 in. broad.*			*Ft. long*	*7¼ in. broad.*			*Ft. long*	*7½ in. broad.*			*Ft. long*	*7¾ in. broad.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	7	0	1	0	7	3	1	0	7	6	1	0	7	9
2	1	2	0	2	1	2	6	2	1	3	0	2	1	3	6
3	1	9	0	3	1	9	9	3	1	10	6	3	1	11	3
4	2	4	0	4	2	5	0	4	2	6	0	4	2	7	0
5	2	11	0	5	3	0	3	5	3	1	6	5	3	2	9
6	3	6	0	6	3	7	6	6	3	9	0	6	3	10	6
7	4	1	0	7	4	2	9	7	4	4	6	7	4	6	3
8	4	8	0	8	4	10	0	8	5	0	0	8	5	2	0
9	5	3	0	9	5	5	3	9	5	7	6	9	5	9	9
10	5	10	0	10	6	0	6	10	6	3	0	10	6	5	6
11	6	5	0	11	6	7	9	11	6	10	6	11	7	1	3
12	7	0	0	12	7	3	0	12	7	6	0	12	7	9	0
13	7	7	0	13	7	10	3	13	8	1	6	13	8	4	9
14	8	2	0	14	8	5	6	14	8	9	0	14	9	0	6
15	8	9	0	15	9	0	9	15	9	4	6	15	9	8	3
16	9	4	0	16	9	8	0	16	10	0	0	16	10	4	0
17	9	11	0	17	10	3	3	17	10	7	6	17	10	11	9
18	10	6	0	18	10	10	6	18	11	3	0	18	11	7	6
19	11	1	0	19	11	5	9	19	11	10	6	19	12	3	3
20	11	8	0	20	12	1	0	20	12	6	0	20	12	11	0
21	12	3	0	21	12	8	3	21	13	1	6	21	13	6	9
22	12	10	0	22	13	3	6	22	13	9	0	22	14	2	6
23	13	5	0	23	13	10	9	23	14	4	6	23	14	10	3
24	14	0	0	24	14	6	0	24	15	0	0	24	15	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	7	0	1	0	0	7	3	1	0	0	7	6	1	0	0	7	9
2	0	1	2	0	2	0	1	2	6	2	0	1	3	0	2	0	1	3	6
3	0	1	9	0	3	0	1	9	9	3	0	1	10	6	3	0	1	11	3
4	0	2	4	0	4	0	2	5	0	4	0	2	6	0	4	0	2	7	0
5	0	2	11	0	5	0	3	0	3	5	0	3	1	6	5	0	3	2	9
6	0	3	6	0	6	0	3	7	6	6	0	3	9	0	6	0	3	10	6
7	0	4	1	0	7	0	4	2	9	7	0	4	4	6	7	0	4	6	3
8	0	4	8	0	8	0	4	10	0	8	0	5	0	0	8	0	5	2	0
9	0	5	3	0	9	0	5	5	3	9	0	5	7	6	9	0	5	9	9
10	0	5	10	0	10	0	6	0	6	10	0	6	3	0	10	0	6	5	6
11	0	6	5	0	11	0	6	7	9	11	0	6	10	6	11	0	7	1	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	1	9	0	¼	0	1	9	9	¼	0	1	10	6	¼	0	1	11	3
½	0	3	6	0	½	0	3	7	6	½	0	3	9	0	½	0	3	10	6
¾	0	5	3	0	¾	0	5	5	3	¾	0	5	7	6	¾	0	5	9	9

Ft. long	8 in. broad.			Ft. long	8¼ in. broad.			Ft. long	8½ in. broad.			Ft. long	8¾ in. broad.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	8	0	1	0	8	3	1	0	8	6	1	0	8	9
2	1	4	0	2	1	4	6	2	1	5	0	2	1	5	6
3	2	0	0	3	2	0	9	3	2	1	6	3	2	2	3
4	2	8	0	4	2	9	0	4	2	10	0	4	2	11	0
5	3	4	0	5	3	5	3	5	3	6	6	5	3	7	9
6	4	0	0	6	4	1	6	6	4	3	0	6	4	4	6
7	4	8	0	7	4	9	9	7	4	11	6	7	5	1	3
8	5	4	0	8	5	6	0	8	5	8	0	8	5	10	0
9	6	0	0	9	6	2	3	9	6	4	6	9	6	6	9
10	6	8	0	10	6	10	6	10	7	1	0	10	7	3	6
11	7	4	0	11	7	6	9	11	7	9	6	11	8	0	3
12	8	0	0	12	8	3	0	12	8	6	0	12	8	9	0
13	8	8	0	13	8	11	3	13	9	2	6	13	9	5	9
14	9	4	0	14	9	7	6	14	9	11	0	14	10	2	6
15	10	0	0	15	10	3	9	15	10	7	6	15	10	11	3
16	10	8	0	16	11	0	0	16	11	4	0	16	11	8	0
17	11	4	0	17	11	8	3	17	12	0	6	17	12	4	9
18	12	0	0	18	12	4	6	18	12	9	0	18	13	1	6
19	12	8	0	19	13	0	9	19	13	5	6	19	13	10	3
20	13	4	0	20	13	9	0	20	14	2	0	20	14	7	0
21	14	0	0	21	14	5	3	21	14	10	6	21	15	3	9
22	14	8	0	22	15	1	6	22	15	7	0	22	16	0	6
23	15	4	0	23	15	9	9	23	16	3	6	23	16	9	3
24	16	0	0	24	16	6	0	24	17	0	0	24	17	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	0	8	0	1	0	0	8	3	1	0	0	8	6	1	0	0	8	9
2	0	1	4	0	2	0	1	4	6	2	0	1	5	0	2	0	1	5	6
3	0	2	0	0	3	0	2	0	9	3	0	2	1	6	3	0	2	2	3
4	0	2	8	0	4	0	2	9	0	4	0	2	10	0	4	0	2	11	0
5	0	3	4	0	5	0	3	5	3	5	0	3	6	6	5	0	3	7	9
6	0	4	0	0	6	0	4	1	6	6	0	4	3	0	6	0	4	4	6
7	0	4	8	0	7	0	4	9	9	7	0	4	11	6	7	0	5	1	3
8	0	5	4	0	8	0	5	6	0	8	0	5	8	0	8	0	5	10	0
9	0	6	0	0	9	0	6	2	3	9	0	6	4	6	9	0	6	6	9
10	0	6	8	0	10	0	6	10	6	10	0	7	1	0	10	0	7	3	6
11	0	7	4	0	11	0	7	6	9	11	0	7	9	6	11	0	8	0	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	2	0	0	¼	0	2	0	9	¼	0	2	1	6	¼	0	2	2	3
½	0	4	0	0	½	0	4	1	6	½	0	4	3	0	½	0	4	4	6
¾	0	6	0	0	¾	0	6	2	3	¾	0	6	4	6	¾	0	6	6	9

Ft. long	*9 in. broad.*			*Ft. long*	*9¼ in. broad.*			*Ft. long*	*9½ in. broad.*			*Ft. long*	*9¾ in. broad.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	0	9	0	1	0	9	3	1	0	9	6	1	0	9	9
2	1	6	0	2	1	6	6	2	1	7	0	2	1	7	6
3	2	3	0	3	2	3	9	3	2	4	6	3	2	5	3
4	3	0	0	4	3	1	0	4	3	2	0	4	3	3	0
5	3	9	0	5	3	10	3	5	3	11	6	5	4	0	9
6	4	6	0	6	4	7	6	6	4	9	0	6	4	10	6
7	5	3	0	7	5	4	9	7	5	6	6	7	5	8	3
8	6	0	0	8	6	2	0	8	6	4	0	8	6	6	0
9	6	9	0	9	6	11	3	9	7	1	6	9	7	3	9
10	7	6	0	10	7	8	6	10	7	11	0	10	8	1	6
11	8	3	0	11	8	5	9	11	8	8	6	11	8	11	3
12	9	0	0	12	9	3	0	12	9	6	0	12	9	9	0
13	9	9	0	13	10	0	3	13	10	3	6	13	10	6	9
14	10	6	0	14	10	9	6	14	11	1	0	14	11	4	6
15	11	3	0	15	11	6	9	15	11	10	6	15	12	2	3
16	12	0	0	16	12	4	0	16	12	8	0	16	13	0	0
17	12	9	0	17	13	1	3	17	13	5	6	17	13	9	9
18	13	6	0	18	13	10	6	18	14	3	0	18	14	7	6
19	14	3	0	19	14	7	9	19	15	0	6	19	15	6	3
20	15	0	0	20	15	5	0	20	15	10	0	20	16	5	0
21	15	9	0	21	16	2	3	21	16	7	6	21	17	0	9
22	16	6	0	22	16	11	6	22	17	5	0	22	17	10	6
23	17	3	0	23	17	8	9	23	18	2	6	23	18	8	3
24	18	0	0	24	18	6	0	24	19	0	0	24	19	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	9	0	1	0	0	9	3	1	0	0	9	6	1	0	0	9	9
2	0	1	6	0	2	0	1	6	6	2	0	1	7	0	2	0	1	7	6
3	0	2	3	0	3	0	2	3	9	3	0	2	4	6	3	0	2	5	3
4	0	3	0	0	4	0	3	1	0	4	0	3	2	0	4	0	3	3	0
5	0	3	9	0	5	0	3	10	3	5	0	3	11	6	5	0	4	0	9
6	0	4	6	0	6	0	4	7	6	6	0	4	9	0	6	0	4	10	6
7	0	5	3	0	7	0	5	4	9	7	0	5	6	6	7	0	5	8	3
8	0	6	0	0	8	0	6	2	0	8	0	6	4	0	8	0	6	6	0
9	0	6	9	0	9	0	6	11	3	9	0	7	1	6	9	0	7	3	9
10	0	7	6	0	10	0	7	8	6	10	0	7	11	0	10	0	8	1	6
11	0	8	3	0	11	0	8	5	9	11	0	8	8	6	11	0	8	11	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	2	3	0	¼	0	2	3	9	¼	0	2	4	6	¼	0	2	5	3
½	0	4	6	0	½	0	4	7	6	½	0	4	9	0	½	0	4	10	6
¾	0	6	9	0	¾	0	6	11	3	¾	0	7	1	6	¾	0	7	3	9

Ft. long	*10 in. broad.*				*Ft. long*	*10¼ in. broad.*				*Ft. long*	*10½ in. broad.*				*Ft. long*	*10¾ in. broad.*			
	Ft.	In.	Pa.			Ft.	In.	Pa.			Ft.	In.	Pa.			Ft.	In.	Pa.	
1	0	10	0		1	0	10	3		1	0	10	6		1	0	10	9	
2	1	8	0		2	1	8	6		2	1	9	0		2	1	9	6	
3	2	6	0		3	2	6	9		3	2	7	6		3	2	8	3	
4	3	4	0		4	3	5	0		4	3	6	0		4	3	7	0	
5	4	2	0		5	4	3	3		5	4	4	6		5	4	5	9	
6	5	0	0		6	5	1	6		6	5	3	0		6	5	4	6	
7	5	10	0		7	5	11	9		7	6	1	6		7	6	3	3	
8	6	8	0		8	6	10	0		8	7	0	0		8	7	2	0	
9	7	6	0		9	7	8	3		9	7	10	6		9	8	0	9	
10	8	4	0		10	8	6	6		10	8	9	0		10	8	11	6	
11	9	2	0		11	9	4	9		11	9	7	6		11	9	10	3	
12	10	0	0		12	10	3	0		12	10	6	0		12	10	9	0	
13	10	10	0		13	11	1	3		13	11	4	6		13	11	7	9	
14	11	8	0		14	11	11	6		14	12	3	0		14	12	6	6	
15	12	6	0		15	12	9	9		15	13	1	6		15	13	5	3	
16	13	4	0		16	13	8	0		16	14	0	0		16	14	4	0	
17	14	2	0		17	14	6	3		17	14	10	6		17	15	2	9	
18	15	0	0		18	15	4	6		18	15	9	0		18	16	1	6	
19	15	10	0		19	16	2	9		19	16	7	6		19	17	0	3	
20	16	8	0		20	17	1	0		20	17	6	0		20	17	11	0	
21	17	6	0		21	17	11	3		21	18	4	6		21	18	9	9	
22	18	4	0		22	18	9	6		22	19	3	0		22	19	8	6	
23	19	2	0		23	19	7	9		23	20	1	6		23	20	7	3	
24	20	0	0		24	20	6	0		24	21	0	0		24	21	6	0	
In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	0	10	0	1	0	0	10	3	1	0	0	10	6	1	0	0	10	9
2	0	1	8	0	2	0	1	8	6	2	0	1	9	0	2	0	1	9	6
3	0	2	6	0	3	0	2	6	9	3	0	2	7	6	3	0	2	8	3
4	0	3	4	0	4	0	3	5	0	4	0	3	6	0	4	0	3	7	0
5	0	4	2	0	5	0	4	3	3	5	0	4	4	6	5	0	4	5	9
6	0	5	0	0	6	0	5	1	6	6	0	5	3	0	6	0	5	4	6
7	0	5	10	0	7	0	5	11	9	7	0	6	1	6	7	0	6	3	3
8	0	6	8	0	8	0	6	10	0	8	0	7	0	0	8	0	7	2	0
9	0	7	6	0	9	0	7	8	3	9	0	7	10	6	9	0	8	0	9
10	0	8	4	0	10	0	8	6	6	10	0	8	9	0	10	0	8	11	6
11	0	9	2	0	11	0	9	4	9	11	0	9	7	6	11	0	9	10	3
Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	2	6	0	¼	0	2	6	9	¼	0	2	7	6	¼	0	2	8	3
½	0	5	0	0	½	0	5	1	6	½	0	5	3	0	½	0	5	4	6
¾	0	7	6	0	¾	0	7	8	3	¾	0	7	10	6	¾	0	8	0	9

Ft. long	11 in. broad				Ft. long	11¼ in. broad				Ft. long	11½ in. broad				Ft. long	11¾ in. broad			
	Ft.	In.	Pa.			Ft.	In.	Pa.			Ft.	In.	Pa.			Ft.	In.	Pa.	
1	0	11	0		1	0	11	3		1	0	11	6		1	0	11	9	
2	1	10	0		2	1	10	6		2	1	11	0		2	1	11	6	
3	2	9	0		3	2	9	9		3	2	10	6		3	2	11	3	
4	3	8	0		4	3	9	0		4	3	10	0		4	3	11	0	
5	4	7	0		5	4	8	3		5	4	9	6		5	4	10	9	
6	5	6	0		6	5	7	6		6	5	9	0		6	5	10	6	
7	6	5	0		7	6	6	9		7	6	8	6		7	6	10	3	
8	7	4	0		8	7	6	0		8	7	8	0		8	7	10	0	
9	8	3	0		9	8	5	3		9	8	7	6		9	8	9	9	
10	9	2	0		10	9	4	6		10	9	7	0		10	9	9	6	
11	10	1	0		11	10	3	9		11	10	6	6		11	10	8	3	
12	11	0	0		12	11	3	0		12	11	6	0		12	11	9	0	
13	11	11	0		13	12	2	3		13	12	5	6		13	12	8	9	
14	12	10	0		14	13	1	6		14	13	5	0		14	13	8	6	
15	13	9	0		15	14	0	9		15	14	4	6		15	14	8	3	
16	14	8	0		16	15	0	0		16	15	4	0		16	15	8	0	
17	15	7	0		17	15	11	3		17	16	3	6		17	16	7	9	
18	16	6	0		18	16	10	6		18	17	3	0		18	17	7	6	
19	17	5	0		19	17	9	9		19	18	2	6		19	18	7	3	
20	18	4	0		20	18	9	0		20	19	2	0		20	19	7	0	
21	19	3	0		21	19	8	3		21	20	1	6		21	20	6	9	
22	20	2	0		22	20	7	6		22	21	1	0		22	21	6	6	
23	21	1	0		23	21	6	9		23	22	0	6		23	22	6	3	
24	22	0	0		24	22	6	0		24	23	0	0		24	23	6	0	
In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	0	11	0	1	0	0	11	3	1	0	0	11	6	1	0	0	11	9
2	0	1	10	0	2	0	1	10	6	2	0	1	11	0	2	0	1	11	6
3	0	2	9	0	3	0	2	9	9	3	0	2	10	6	3	0	2	11	3
4	0	3	8	0	4	0	3	9	0	4	0	3	10	0	4	0	3	11	0
5	0	4	7	0	5	0	4	8	3	5	0	4	9	6	5	0	4	10	9
6	0	5	6	0	6	0	5	7	6	6	0	5	9	0	6	0	5	10	6
7	0	6	5	0	7	0	6	6	9	7	0	6	8	6	7	0	6	10	3
8	0	7	4	0	8	0	7	6	0	8	0	7	8	0	8	0	7	10	0
9	0	8	3	0	9	0	8	5	3	9	0	8	7	6	9	0	8	9	9
10	0	9	2	0	10	0	9	4	6	10	0	9	7	0	10	0	9	9	6
11	0	10	1	0	11	0	10	3	9	11	0	10	6	6	11	0	10	9	3
Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	2	9	0	¼	0	2	9	9	¼	0	2	10	6	¼	0	2	11	3
½	0	5	6	0	½	0	5	7	6	½	0	5	9	0	½	0	5	10	6
¾	0	8	3	0	¾	0	8	5	3	¾	0	8	7	6	¾	0	8	9	9

Ft. long	12 in. broad.			Ft. long	12¼ in. broad.			Ft. long	12½ in. broad.			Ft. long	12¾ in. broad.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	0	0	1	1	0	3	1	1	0	6	1	1	0	9
2	2	0	0	2	2	0	6	2	2	1	0	2	2	1	6
3	3	0	0	3	3	0	9	3	3	1	6	3	3	2	3
4	4	0	0	4	4	1	0	4	4	2	0	4	4	3	0
5	5	0	0	5	5	1	3	5	5	2	6	5	5	3	9
6	6	0	0	6	6	1	6	6	6	3	0	6	6	4	6
7	7	0	0	7	7	1	9	7	7	3	6	7	7	5	3
8	8	0	0	8	8	2	0	8	8	4	0	8	8	6	0
9	9	0	0	9	9	2	3	9	9	4	6	9	9	6	9
10	10	0	0	10	10	2	6	10	10	5	0	10	10	7	6
11	11	0	0	11	11	2	9	11	11	5	6	11	11	8	3
12	12	0	0	12	12	3	0	12	12	6	0	12	12	9	0
13	13	0	0	13	13	3	3	13	13	6	6	13	13	9	9
14	14	0	0	14	14	3	6	14	14	7	0	14	14	10	6
15	15	0	0	15	15	3	9	15	15	7	6	15	15	11	3
16	16	0	0	16	16	4	0	16	16	8	0	16	17	0	0
17	17	0	0	17	17	4	3	17	17	8	6	17	18	0	9
18	18	0	0	18	18	4	6	18	18	9	0	18	19	1	6
19	19	0	0	19	19	4	9	19	19	9	6	19	20	2	3
20	20	0	0	20	20	5	0	20	20	10	0	20	21	3	0
21	21	0	0	21	21	5	3	21	21	10	6	21	22	3	9
22	22	0	0	22	22	5	6	22	22	11	0	22	23	4	6
23	23	0	0	23	23	5	9	23	23	11	6	23	24	5	3
24	24	0	0	24	24	6	0	24	25	0	0	24	25	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	0	0	1	0	1	0	3	1	0	1	0	6	1	0	1	0	9
2	0	2	0	0	2	0	2	0	6	2	0	2	1	0	2	0	2	1	6
3	0	3	0	0	3	0	3	0	9	3	0	3	1	6	3	0	3	2	3
4	0	4	0	0	4	0	4	1	0	4	0	4	2	0	4	0	4	3	0
5	0	5	0	0	5	0	5	1	3	5	0	5	2	6	5	0	5	3	9
6	0	6	0	0	6	0	6	1	6	6	0	6	3	0	6	0	6	4	6
7	0	7	0	0	7	0	7	1	9	7	0	7	3	6	7	0	7	5	3
8	0	8	0	0	8	0	8	2	0	8	0	8	4	0	8	0	8	6	0
9	0	9	0	0	9	0	9	2	3	9	0	9	4	6	9	0	9	6	9
10	0	10	0	0	10	0	10	2	6	10	0	10	5	0	10	0	10	7	6
11	0	11	0	0	11	0	11	2	9	11	0	11	5	6	11	0	11	8	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	3	0	0	¼	0	3	0	9	¼	0	3	1	6	¼	0	3	2	3
½	0	6	0	0	½	0	6	1	6	½	0	6	3	0	½	0	6	4	6
¾	0	9	0	0	¾	0	9	2	3	¾	0	9	4	6	¾	0	9	6	0

Ft. long	13 in. broad.			Ft. long	13¼ in. broad.			Ft. long	13½ in. broad.			Ft. long	13¾ in. broad.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	1	0	1	1	1	3	1	1	1	6	1	1	1	9
2	2	2	0	2	2	2	6	2	2	3	0	2	2	3	6
3	3	3	0	3	3	3	9	3	3	4	6	3	3	5	3
4	4	4	0	4	4	5	0	4	4	6	0	4	4	7	0
5	5	5	0	5	5	6	3	5	5	7	6	5	5	8	9
6	6	6	0	6	6	7	6	6	6	9	0	6	6	10	6
7	7	7	0	7	7	8	9	7	7	10	6	7	8	0	3
8	8	8	0	8	8	10	0	8	9	0	0	8	9	2	0
9	9	9	0	9	9	11	3	9	10	1	6	9	10	3	9
10	10	10	0	10	11	0	6	10	11	3	0	10	11	5	6
11	11	11	0	11	12	1	9	11	12	4	6	11	12	7	3
12	13	0	0	12	13	3	0	12	13	6	0	12	13	9	0
13	14	1	0	13	14	4	3	13	14	7	6	13	14	10	9
14	15	2	0	14	15	5	6	14	15	9	0	14	16	0	6
15	16	3	0	15	16	6	9	15	16	10	6	15	17	2	3
16	17	4	0	16	17	8	0	16	18	0	0	16	18	4	0
17	18	5	0	17	18	9	3	17	19	1	6	17	19	5	9
18	19	6	0	18	19	10	6	18	20	3	0	18	20	7	6
19	20	7	0	19	20	11	9	19	21	4	6	19	21	9	3
20	21	8	0	20	22	1	0	20	22	6	0	20	22	11	0
21	22	9	0	21	23	2	3	21	23	7	6	21	24	0	9
22	23	10	0	22	24	3	6	22	24	9	0	22	25	2	6
23	24	11	0	23	25	4	9	23	25	10	6	23	26	4	3
24	26	0	0	24	26	6	0	24	27	0	0	24	27	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	1	0	1	0	1	1	3	1	0	1	1	6	1	0	1	1	9
2	0	2	2	0	2	0	2	2	6	2	0	2	3	0	2	0	2	3	6
3	0	3	3	0	3	0	3	3	9	3	0	3	4	6	3	0	3	5	3
4	0	4	4	0	4	0	4	5	0	4	0	4	6	0	4	0	4	7	0
5	0	5	5	0	5	0	5	6	3	5	0	5	7	6	5	0	5	8	9
6	0	6	6	0	6	0	6	7	6	6	0	6	9	0	6	0	6	10	6
7	0	7	7	0	7	0	7	8	9	7	0	7	10	6	7	0	8	0	3
8	0	8	8	0	8	0	8	10	0	8	0	9	0	0	8	0	9	2	0
9	0	9	9	0	9	0	9	11	3	9	0	10	1	6	9	0	10	3	9
10	0	10	10	0	10	0	11	0	6	10	0	11	3	0	10	0	11	5	6
11	0	11	11	0	11	0	12	1	9	11	1	0	4	6	11	1	0	7	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	3	3	0	¼	0	3	3	9	¼	0	3	4	6	¼	0	3	5	3
½	0	6	6	0	½	0	6	7	6	½	0	6	9	0	½	0	6	10	6
¾	0	9	9	0	¾	0	9	11	3	¾	0	10	1	6	¾	0	10	3	9

Ft. long	14 *in. broad.* Ft.	In.	Pa.	*Ft. long*	14¼ *in. broad.* Ft.	In.	Pa.	*Ft. long*	14½ *in. broad.* Ft.	In.	Pa.	*Ft. long*	14¾ *in. broad.* Ft.	In.	Pa.
1	1	2	0	1	1	2	3	1	1	2	6	1	1	2	9
2	2	4	0	2	2	4	6	2	2	5	0	2	2	5	6
3	3	6	0	3	3	6	9	3	3	7	6	3	3	8	3
4	4	8	0	4	4	9	0	4	4	10	0	4	4	11	0
5	5	10	0	5	5	11	3	5	6	0	6	5	6	1	9
6	7	0	0	6	7	1	6	6	7	3	0	6	7	4	6
7	8	2	0	7	8	3	9	7	8	5	6	7	8	7	3
8	9	4	0	8	9	6	0	8	9	8	0	8	9	10	0
9	10	6	0	9	10	8	3	9	10	10	6	9	11	0	9
10	11	8	0	10	11	10	6	10	12	1	0	10	12	3	6
11	12	10	0	11	13	0	9	11	13	3	6	11	13	6	3
12	14	0	0	12	14	3	0	12	14	6	0	12	14	9	0
13	15	2	0	13	15	5	3	13	15	8	6	13	15	11	9
14	16	4	0	14	16	7	6	14	16	11	0	14	17	2	6
15	17	6	0	15	17	9	9	15	18	1	6	15	18	5	3
16	18	8	0	16	19	0	0	16	19	4	0	16	19	8	0
17	19	10	0	17	20	2	3	17	20	6	6	17	20	10	9
18	21	0	0	18	21	4	6	18	21	9	0	18	22	1	6
19	22	2	0	19	22	6	9	19	22	11	6	19	23	4	3
20	23	4	0	20	23	9	0	20	24	2	0	20	24	7	0
21	24	6	0	21	24	11	3	21	25	4	6	21	25	9	9
22	25	8	0	22	26	1	6	22	26	7	0	22	27	0	6
23	26	10	0	23	27	3	9	23	27	9	6	23	28	3	3
24	28	0	0	24	28	6	0	24	29	0	0	24	29	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	1	2	0	1	0	1	2	3	1	0	1	2	6	1	0	1	2	9
2	0	2	4	0	2	0	2	4	6	2	0	2	5	0	2	0	2	5	6
3	0	3	6	0	3	0	3	6	9	3	0	3	7	6	3	0	3	8	3
4	0	4	8	0	4	0	4	9	0	4	0	4	10	0	4	0	4	11	0
5	0	5	10	0	5	0	5	11	3	5	0	6	0	6	5	0	6	1	9
6	0	7	0	0	6	0	7	1	6	6	0	7	3	0	6	0	7	4	6
7	0	8	2	0	7	0	8	3	9	7	0	8	5	6	7	0	8	7	3
8	0	9	4	0	8	0	9	6	0	8	0	9	8	0	8	0	9	10	0
9	0	10	6	0	9	0	10	8	3	9	0	10	10	6	9	0	11	0	9
10	0	11	8	0	10	0	11	10	6	10	1	0	1	0	10	1	0	3	6
11	1	0	10	0	11	1	1	0	9	11	1	1	3	6	11	1	1	6	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	3	6	0	¼	0	3	6	9	¼	0	3	7	6	¼	0	3	8	3
½	0	7	0	0	½	0	7	1	6	½	0	7	3	0	½	0	7	4	6
¾	0	10	6	0	¾	0	10	8	3	¾	0	10	10	6	¾	0	11	0	9

Ft. long	15 in. broad.			Ft. long	15¼ in. broad.			Ft. long	15½ in. broad.			Ft. long	15¾ in. broad.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	3	0	1	1	3	3	1	1	3	6	1	1	3	9
2	2	6	0	2	2	6	6	2	2	7	0	2	2	7	6
3	3	9	0	3	3	9	9	3	3	10	6	3	3	11	3
4	5	0	0	4	5	1	0	4	5	2	0	4	5	3	0
5	6	3	0	5	6	4	3	5	6	5	6	5	6	6	9
6	7	6	0	6	7	7	6	6	7	9	0	6	7	10	6
7	8	9	0	7	8	10	9	7	9	0	6	7	9	2	3
8	10	0	0	8	10	2	0	8	10	4	0	8	10	6	0
9	11	3	0	9	11	5	3	9	11	7	6	9	11	9	9
10	12	6	0	10	12	8	6	10	12	11	0	10	13	1	6
11	13	9	0	11	13	11	9	11	14	2	6	11	14	5	3
12	15	0	0	12	15	3	0	12	15	6	0	12	15	9	0
13	16	3	0	13	16	6	3	13	16	9	6	13	17	0	9
14	17	6	0	14	17	9	6	14	18	1	0	14	18	4	6
15	18	9	0	15	19	0	9	15	19	4	6	15	19	8	3
16	20	0	0	16	20	4	0	16	20	8	0	16	21	0	0
17	21	3	0	17	21	7	3	17	21	11	6	17	22	3	9
18	22	6	0	18	22	10	6	18	23	3	0	18	23	7	6
19	23	9	0	19	24	1	9	19	24	6	6	19	24	11	3
20	25	0	0	20	25	5	0	20	25	10	0	20	26	3	0
21	26	3	0	21	26	8	3	21	27	1	6	21	27	6	9
22	27	6	0	22	27	11	6	22	28	5	0	22	28	10	6
23	28	9	0	23	29	2	9	23	29	8	6	23	30	2	3
24	30	0	0	24	30	6	0	24	31	0	0	24	31	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	3	0	1	0	1	3	3	1	0	1	3	6	1	0	1	3	9
2	0	2	6	0	2	0	2	6	6	2	0	2	7	0	2	0	2	7	6
3	0	3	9	0	3	0	3	9	9	3	0	3	10	6	3	0	3	11	3
4	0	5	0	0	4	0	5	1	0	4	0	5	2	0	4	0	5	3	0
5	0	6	3	0	5	0	6	4	3	5	0	6	5	6	5	0	6	6	9
6	0	7	6	0	6	0	7	7	6	6	0	7	9	0	6	0	7	10	6
7	0	8	9	0	7	0	8	10	9	7	0	9	0	6	7	0	9	2	3
8	0	10	0	0	8	0	10	2	0	8	0	10	4	0	8	0	10	6	0
9	0	11	3	0	9	0	11	5	3	9	0	11	7	6	9	0	11	9	9
10	1	0	6	0	10	1	0	8	6	10	1	0	11	0	10	1	1	1	6
11	1	1	9	0	11	1	1	11	9	11	1	2	2	6	11	1	2	5	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	3	9	0	¼	0	3	9	9	¼	0	3	10	6	¼	0	3	11	3
½	0	7	6	0	½	0	7	7	6	½	0	7	9	0	½	0	7	10	6
¾	0	11	3	0	¾	0	11	5	3	¾	0	11	7	6	¾	0	11	9	9

Ft. long	16 in. broad Ft.	In.	Pa.	Ft. long	16¼ in. broad Ft.	In.	Pa.	Ft. long	16½ in. broad Ft.	In.	Pa.	Ft. long	16¾ in. broad Ft.	In.	Pa.
1	1	4	0	1	1	4	3	1	1	4	6	1	1	4	9
2	2	8	0	2	2	8	6	2	2	9	0	2	2	9	6
3	4	0	0	3	4	0	9	3	4	1	6	3	4	2	3
4	5	4	0	4	5	5	0	4	5	3	0	4	5	7	0
5	6	8	0	5	6	9	3	5	6	10	6	5	6	11	9
6	8	0	0	6	8	1	6	6	8	3	0	6	8	4	6
7	9	4	0	7	9	5	9	7	9	7	6	7	9	9	3
8	10	8	0	8	10	10	0	8	11	0	0	8	11	2	0
9	12	0	0	9	12	2	3	9	12	4	6	9	12	6	9
10	13	4	0	10	13	6	6	10	13	9	0	10	13	11	6
11	14	8	0	11	14	10	9	11	15	1	6	11	15	4	3
12	16	0	0	12	16	3	0	12	16	6	0	12	16	9	0
13	17	4	0	13	17	7	3	13	17	10	6	13	18	1	9
14	18	8	0	14	18	11	6	14	19	3	0	14	19	6	6
15	20	0	0	15	20	3	9	15	20	7	6	15	20	11	3
16	21	4	0	16	21	8	0	16	22	0	0	16	22	4	0
17	22	8	0	17	23	0	3	17	23	4	6	17	23	8	9
18	24	0	0	18	24	4	6	18	24	9	0	18	25	1	6
19	25	4	0	19	25	8	9	19	26	1	6	19	26	6	3
20	26	8	0	20	27	1	0	20	27	6	0	20	27	11	0
21	28	0	0	21	28	5	3	21	28	10	6	21	29	3	9
22	29	4	0	22	29	9	6	22	30	3	0	22	30	8	6
23	30	8	0	23	31	1	9	23	31	7	6	23	32	1	3
24	32	0	0	24	32	6	0	24	33	0	0	24	33	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	4	0	1	0	1	4	3	1	0	1	4	6	1	0	1	4	9
2	0	2	8	0	2	0	2	8	6	2	0	2	9	0	2	0	2	9	6
3	0	4	0	0	3	0	4	0	9	3	0	4	1	6	3	0	4	2	3
4	0	5	4	0	4	0	5	5	0	4	0	5	6	0	4	0	5	7	0
5	0	6	8	0	5	0	6	9	3	5	0	6	10	6	5	0	6	11	9
6	0	8	0	0	6	0	8	1	6	6	0	8	3	0	6	0	8	4	6
7	0	9	4	0	7	0	9	5	9	7	0	9	7	6	7	0	9	9	3
8	0	10	8	0	8	0	10	10	0	8	0	11	0	0	8	0	11	2	0
9	1	0	0	0	9	1	0	2	3	9	1	0	4	6	9	1	0	6	9
10	1	1	4	0	10	1	1	6	6	10	1	1	9	0	10	1	1	11	6
11	1	2	8	0	11	1	2	10	9	11	1	3	1	6	11	1	3	4	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	4	0	0	¼	0	4	0	9	¼	0	4	1	6	¼	0	4	2	3
½	0	8	0	0	½	0	8	1	6	½	0	8	3	0	½	0	8	4	6
¾	1	0	0	0	¾	1	0	2	3	¾	1	0	4	6	¾	1	0	6	9

Ft. long	17 in. broad Ft.	In.	Pa.	Ft. long	17¼ in. broad Ft.	In.	Pa.	Ft. long	17½ in. broad Ft.	In.	Pa.	Ft. long	17¾ in. broad Ft.	In.	Pa.
1	1	5	0	1	1	5	3	1	1	5	6	1	1	5	9
2	2	10	0	2	2	10	6	2	2	11	0	2	2	11	6
3	4	3	0	3	4	3	9	3	4	4	6	3	4	5	3
4	5	8	0	4	5	9	0	4	5	10	0	4	5	11	0
5	7	1	0	5	7	2	3	5	7	3	6	5	7	4	9
6	8	6	0	6	8	7	6	6	8	9	0	6	8	10	6
7	9	11	0	7	10	0	9	7	10	2	6	7	10	4	3
8	11	4	0	8	11	6	0	8	11	8	0	8	11	10	0
9	12	9	0	9	12	11	3	9	13	1	6	9	13	3	9
10	14	2	0	10	14	4	6	10	14	7	0	10	14	9	6
11	15	7	0	11	15	9	9	11	16	0	6	11	16	3	3
12	17	0	0	12	17	3	0	12	17	6	0	12	17	9	0
13	18	5	0	13	18	8	3	13	18	11	6	13	19	2	9
14	19	10	0	14	20	1	6	14	20	5	0	14	20	8	6
15	21	3	0	15	21	6	9	15	21	10	6	15	22	2	3
16	22	8	0	16	23	0	0	16	23	4	0	16	23	8	0
17	24	1	0	17	24	5	3	17	24	9	6	17	25	1	9
18	25	6	0	18	25	10	6	18	26	3	0	18	26	7	6
19	26	11	0	19	27	3	9	19	27	8	6	19	28	1	3
20	28	4	0	20	28	9	0	20	29	2	0	20	29	7	0
21	29	9	0	21	30	2	3	21	30	7	6	21	31	0	9
22	31	2	0	22	31	7	6	22	32	1	0	22	32	6	6
23	32	7	0	23	33	0	9	23	33	6	6	23	34	0	3
24	34	0	0	24	34	6	0	24	35	0	0	24	35	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	5	0	1	0	1	5	3	1	0	1	5	6	1	0	1	5	9
2	0	2	10	0	2	0	2	10	6	2	0	2	11	0	2	0	2	11	6
3	0	4	3	0	3	0	4	3	9	3	0	4	4	6	3	0	4	5	3
4	0	5	8	0	4	0	5	9	0	4	0	5	10	0	4	0	5	11	0
5	0	7	1	0	5	0	7	2	3	5	0	7	3	6	5	0	7	4	9
6	0	8	6	0	6	0	8	7	6	6	0	8	9	0	6	0	8	10	6
7	0	9	11	0	7	0	10	0	9	7	0	10	2	6	7	0	10	4	3
8	0	11	4	0	8	0	11	6	0	8	0	11	8	0	8	0	11	10	0
9	1	0	9	0	9	1	0	11	3	9	1	1	1	6	9	1	1	3	9
10	1	2	2	0	10	1	2	4	6	10	1	2	7	0	10	1	2	9	6
11	1	3	7	0	11	1	3	9	9	11	1	4	0	6	11	1	4	3	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	4	3	0	¼	0	4	3	9	¼	0	4	4	6	¼	0	4	5	3
½	0	8	6	0	½	0	8	7	6	½	0	8	9	0	½	0	8	10	6
¾	1	0	9	0	¾	1	0	11	3	¾	1	1	1	6	¾	1	1	3	9

Ft. long	18 in. broad.			Ft. long	18¼ in. broad.			Ft. long	18½ in. broad.			Ft. long	18¾ in. broad.		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	6	0	1	1	6	3	1	1	6	6	1	1	6	9
2	3	0	0	2	3	0	6	2	3	1	0	2	3	1	6
3	4	6	0	3	4	6	9	3	4	7	6	3	4	8	3
4	6	0	0	4	6	1	0	4	6	2	0	4	6	3	0
5	7	6	0	5	7	7	3	5	7	8	6	5	7	9	9
6	9	0	0	6	9	1	6	6	9	3	0	6	9	4	6
7	10	6	0	7	11	7	9	7	10	9	6	7	10	11	3
8	12	0	0	8	12	2	0	8	12	4	0	8	12	6	0
9	13	6	0	9	13	8	3	9	13	10	6	9	14	0	9
10	15	0	0	10	15	2	6	10	15	5	0	10	15	7	6
11	16	6	0	11	16	8	9	11	16	11	6	11	17	2	3
12	18	0	0	12	18	3	0	12	18	6	0	12	18	9	0
13	19	6	0	13	19	9	3	13	20	0	6	13	20	3	9
14	21	0	0	14	21	3	6	14	21	7	0	14	21	10	6
15	22	6	0	15	22	9	9	15	23	1	6	15	23	5	3
16	24	0	0	16	24	4	0	16	24	8	0	16	25	0	0
17	25	6	0	17	25	10	3	17	26	2	6	17	26	6	9
18	27	0	0	18	27	4	6	18	27	9	0	18	28	1	6
19	28	6	0	19	28	10	9	19	29	3	6	19	29	8	3
20	30	0	0	20	30	5	0	20	30	10	0	20	31	3	0
21	31	6	0	21	31	11	3	21	32	4	6	21	32	9	9
22	33	0	0	22	33	5	6	22	33	11	0	22	34	4	6
23	34	6	0	23	34	11	9	23	35	5	6	23	35	11	3
24	36	0	0	24	36	6	0	24	37	0	0	24	37	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	6	0	1	0	1	6	3	1	0	1	6	6	1	0	1	6	9
2	0	3	0	0	2	0	3	0	6	2	0	3	1	0	2	0	3	1	6
3	0	4	6	0	3	0	4	6	9	3	0	4	7	6	3	0	4	8	3
4	0	6	0	0	4	0	6	1	0	4	0	6	2	0	4	0	6	3	0
5	0	7	6	0	5	0	7	7	3	5	0	7	8	6	5	0	7	9	9
6	0	9	0	0	6	0	9	1	6	6	0	9	3	0	6	0	9	4	6
7	0	10	6	0	7	0	10	7	9	7	0	10	9	6	7	0	10	11	3
8	1	0	0	0	8	1	0	2	0	8	1	0	4	0	8	1	0	6	0
9	1	1	6	0	9	1	1	8	3	9	1	1	10	6	9	1	2	0	9
10	1	3	0	0	10	1	3	2	6	10	1	3	5	0	10	1	3	7	6
11	1	4	6	0	11	1	4	8	9	11	1	4	11	6	11	1	5	2	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	4	6	0	¼	0	4	6	9	¼	0	4	7	6	¼	0	4	8	3
½	0	9	0	0	½	0	9	1	6	½	0	9	3	0	½	0	9	4	6
¾	1	1	6	0	¾	1	1	8	3	¾	1	1	10	6	¾	1	2	0	9

Ft. long	19 in. broad. Ft.	In.	Pa.	Ft. long	19¼ in. broad. Ft.	In.	Pa.	Ft. long	19½ in. broad. Ft.	In.	Pa.	Ft. long	19¾ in. broad. Ft.	In.	Pa.
1	1	7	0	1	1	7	3	1	1	7	6	1	1	7	9
2	3	2	0	2	3	2	6	2	3	3	0	2	3	3	6
3	4	9	0	3	4	9	9	3	4	10	6	3	4	11	3
4	6	4	0	4	6	5	0	4	6	6	0	4	6	7	0
5	7	11	0	5	8	0	3	5	8	1	6	5	8	2	9
6	9	6	0	6	9	7	6	6	9	9	0	6	9	10	6
7	11	1	0	7	11	2	9	7	11	4	6	7	11	6	3
8	12	8	0	8	12	10	0	8	13	0	0	8	13	2	0
9	14	3	0	9	14	5	3	9	14	7	6	9	14	9	9
10	15	10	0	10	16	0	6	10	16	3	0	10	16	5	6
11	17	5	0	11	17	7	9	11	17	10	6	11	18	1	3
12	19	0	0	12	19	3	0	12	19	6	0	12	19	9	0
13	20	7	0	13	20	10	3	13	21	1	6	13	21	4	9
14	22	2	0	14	22	5	6	14	22	9	0	14	23	0	6
15	23	9	0	15	24	0	9	15	24	4	6	15	24	8	3
16	25	4	0	16	25	8	0	16	26	0	0	16	26	4	0
17	26	11	0	17	27	3	3	17	27	7	6	17	27	11	9
18	28	6	0	18	28	10	6	18	29	3	0	18	29	7	6
19	30	1	0	19	30	5	9	19	30	10	6	19	31	3	3
20	31	8	0	20	32	1	0	20	32	6	0	20	32	11	0
21	33	3	0	21	33	8	3	21	34	1	6	21	34	6	9
22	34	10	0	22	35	3	6	22	35	9	0	22	36	2	6
23	36	5	0	23	36	10	9	23	37	4	6	23	37	10	3
24	38	0	0	24	38	6	0	24	39	0	0	24	39	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	7	0	1	0	1	7	3	1	0	1	7	6	1	0	1	7	9
2	0	3	2	0	2	0	3	2	6	2	0	3	3	0	2	0	3	3	6
3	0	4	9	0	3	0	4	9	9	3	0	4	10	6	3	0	4	11	3
4	0	6	4	0	4	0	6	5	0	4	0	6	6	0	4	0	6	7	0
5	0	7	11	0	5	0	8	0	3	5	0	8	1	6	5	0	8	2	9
6	0	9	6	0	6	0	9	7	6	6	0	9	9	0	6	0	9	10	6
7	0	11	1	0	7	0	11	2	9	7	0	11	4	6	7	0	11	6	3
8	1	0	8	0	8	1	0	10	0	8	1	1	0	0	8	1	1	2	0
9	1	2	3	0	9	1	2	5	3	9	1	2	7	6	9	1	2	9	9
10	1	3	10	0	10	1	4	0	6	10	1	4	3	0	10	1	4	5	6
11	1	5	5	0	11	1	5	7	9	11	1	5	10	6	11	1	6	1	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	4	9	0	¼	0	4	9	9	¼	0	4	10	6	¼	0	4	11	3
½	0	9	6	0	½	0	9	7	6	½	0	9	9	0	½	0	9	10	6
¾	1	2	3	0	¾	1	2	5	3	¾	1	2	7	6	¾	1	2	9	9

Ft. long	20 *in. broad.* Ft.	In.	Pa.	*Ft. long*	20¼ *in. broad.* Ft.	In.	Pa.	*Ft. long*	20½ *in. broad.* Ft.	In.	Pa.	*Ft. long*	20¾ *in. broad.* Ft.	In.	Pa.
1	1	8	0	1	1	8	3	1	1	8	6	1	1	8	9
2	3	4	0	2	3	4	6	2	3	5	0	2	3	5	6
3	5	0	0	3	5	0	9	3	5	1	6	3	5	2	3
4	6	8	0	4	6	9	0	4	6	10	0	4	6	11	0
5	8	4	0	5	8	5	3	5	8	6	6	5	8	7	9
6	10	0	0	6	10	1	6	6	10	3	0	6	10	4	6
7	11	8	0	7	11	9	9	7	11	11	6	7	12	1	3
8	13	4	0	8	13	6	0	8	13	8	0	8	13	10	0
9	15	0	0	9	15	2	3	9	15	4	6	9	15	6	9
10	16	8	0	10	16	10	6	10	17	1	0	10	17	3	6
11	18	4	0	11	18	6	9	11	18	9	6	11	19	0	3
12	20	0	0	12	20	3	0	12	20	0	0	12	20	9	0
13	21	8	0	13	21	11	3	13	22	2	6	13	22	5	9
14	23	4	0	14	23	6	6	14	23	11	0	14	24	2	6
15	25	0	0	15	25	3	9	15	25	7	6	15	25	11	3
16	26	8	0	16	27	0	0	16	27	4	0	16	27	8	0
17	28	4	0	17	28	8	3	17	29	0	6	17	29	4	9
18	30	0	0	18	30	4	6	18	30	9	0	18	31	1	6
19	31	8	0	19	32	0	9	19	32	5	6	19	32	10	3
20	33	4	0	20	33	9	0	20	34	2	0	20	34	7	0
21	35	0	0	21	35	5	3	21	35	10	6	21	36	3	9
22	36	8	0	22	37	1	6	22	37	7	0	22	38	0	6
23	38	4	0	23	38	9	9	23	39	3	6	23	39	9	3
24	40	0	0	24	40	6	0	24	41	0	0	24	41	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	1	8	0	1	0	1	8	3	1	0	1	8	6	1	0	1	8	9
2	0	3	4	0	2	0	3	4	6	2	0	3	5	0	2	0	3	5	6
3	0	5	0	0	3	0	5	0	9	3	0	5	1	6	3	0	5	2	3
4	0	6	8	0	4	0	6	9	0	4	0	6	10	0	4	0	6	11	0
5	0	8	4	0	5	0	8	5	3	5	0	8	6	6	5	0	8	7	9
6	0	10	0	0	6	0	10	1	6	6	0	10	3	0	6	0	10	4	6
7	0	11	8	0	7	0	11	9	9	7	0	11	11	6	7	1	0	1	3
8	1	1	4	0	8	1	1	6	0	8	1	1	8	0	8	1	1	10	0
9	1	3	0	0	9	1	3	2	3	9	1	3	4	6	9	1	3	6	9
10	1	4	8	0	10	1	4	10	6	10	1	5	1	0	10	1	5	3	6
11	1	6	4	0	11	1	6	6	9	11	1	6	9	6	11	1	7	0	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	5	0	0	¼	0	5	0	9	¼	0	5	1	6	¼	0	5	2	3
½	0	10	0	0	½	0	10	1	6	½	0	10	3	0	½	0	10	4	6
¾	1	3	0	0	¾	1	3	2	3	¾	1	3	4	6	¾	1	3	6	9

Ft. long	*21 in. broad.* Ft.	In.	Pa.	*Ft. long*	*21¼ in broad.* Ft.	In.	Pa.	*Ft. long*	*21½ in. broad.* Ft.	In.	Pa.	*Ft. long*	*21¾ in. broad.* Ft.	In.	Pa.
1	1	9	0	1	1	9	3	1	1	9	6	1	1	9	9
2	3	6	0	2	3	6	6	2	3	7	0	2	3	7	6
3	5	3	0	3	5	3	9	3	5	4	6	3	5	5	3
4	7	0	0	4	7	1	0	4	7	2	0	4	7	3	0
5	8	9	0	5	8	10	3	5	8	11	6	5	9	0	9
6	10	6	0	6	10	7	6	6	10	9	0	6	10	10	6
7	12	3	0	7	12	4	9	7	12	6	6	7	12	8	3
8	14	0	0	8	14	2	0	8	14	4	0	8	14	6	0
9	15	9	0	9	15	11	3	9	16	1	6	9	16	3	9
10	17	6	0	10	17	8	6	10	17	11	0	10	18	1	6
11	19	3	0	11	19	5	9	11	19	8	6	11	19	11	3
12	21	0	0	12	21	3	0	12	21	6	0	12	21	9	0
13	22	9	0	13	23	0	3	13	23	3	6	13	23	6	9
14	24	6	0	14	24	9	6	14	25	1	0	14	25	4	6
15	26	3	0	15	26	6	9	15	26	10	6	15	27	2	3
16	28	0	0	16	28	4	0	16	28	8	0	16	29	0	0
17	29	9	0	17	30	1	3	17	30	5	6	17	30	9	9
18	31	6	0	18	31	10	6	18	32	3	0	18	32	7	6
19	33	3	0	19	33	7	9	19	34	0	6	19	34	5	3
20	35	0	0	20	35	5	0	20	35	10	0	20	36	3	0
21	36	9	0	21	37	2	3	21	37	7	6	21	38	0	9
22	38	6	0	22	38	11	6	22	39	5	0	22	39	10	6
23	40	3	0	23	40	8	9	23	41	2	6	23	41	8	3
24	42	0	0	24	42	6	0	24	43	0	0	24	43	6	0

In. long	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.	*In. long*	Ft.	In.	Pa.	S.
1	0	1	9	0	1	0	1	9	3	1	0	1	9	6	1	0	1	9	9
2	0	3	6	0	2	0	3	6	6	2	0	3	7	0	2	0	3	7	6
3	0	5	3	0	3	0	5	3	9	3	0	5	4	6	3	0	5	5	3
4	0	7	0	0	4	0	7	1	0	4	0	7	2	0	4	0	7	3	0
5	0	8	9	0	5	0	8	10	3	5	0	8	11	6	5	0	9	0	9
6	0	10	6	0	6	0	10	7	6	6	0	10	9	0	6	0	10	10	6
7	1	0	3	0	7	1	0	4	9	7	1	0	6	6	7	1	0	8	3
8	1	2	0	0	8	1	2	2	0	8	1	2	4	0	8	1	2	6	0
9	1	3	9	0	9	1	3	11	3	9	1	4	1	6	9	1	4	3	9
10	1	5	6	0	10	1	5	8	6	10	1	5	11	0	10	1	6	1	6
11	1	7	3	0	11	1	7	5	9	11	1	7	8	6	11	1	7	11	3

Qrs. in. long	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.	*Qrs. in. long*	In.	Pa.	S.	T.
¼	0	5	3	0	¼	0	5	3	9	¼	0	5	4	6	¼	0	5	5	3
½	0	10	6	0	½	0	10	7	6	½	0	10	9	0	½	0	10	10	6
¾	1	3	9	0	¾	1	3	11	3	¾	1	4	1	6	¾	1	4	3	9

Ft. long	22 *in. broad.*			Ft. long	22¼ *in. broad.*			Ft. long	22½ *in. broad.*			Ft. long	22¾ *in. broad.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	10	0	1	1	10	3	1	1	10	6	1	1	10	9
2	3	8	0	2	3	8	6	2	3	9	0	2	3	9	6
3	5	6	0	3	5	6	9	3	5	7	6	3	5	8	3
4	7	4	0	4	7	5	0	4	7	6	0	4	7	7	0
5	9	2	0	5	9	3	3	5	9	4	6	5	9	5	9
6	11	0	0	6	11	1	6	6	11	3	0	6	11	4	6
7	12	10	0	7	12	11	9	7	13	1	6	7	13	3	3
8	14	8	0	8	14	10	0	8	15	0	0	8	15	2	0
9	16	6	0	9	16	8	3	9	16	10	6	9	17	0	9
10	18	4	0	10	18	6	6	10	18	9	0	10	18	11	6
11	20	2	0	11	20	4	9	11	20	7	6	11	20	10	3
12	22	0	0	12	22	3	0	12	22	6	0	12	22	9	0
13	23	10	0	13	24	1	3	13	24	4	6	13	24	7	9
14	25	8	0	14	25	11	6	14	26	3	0	14	26	6	6
15	27	6	0	15	27	9	9	15	28	1	6	15	28	5	3
16	29	4	0	16	29	8	0	16	30	0	0	16	30	4	0
17	31	2	0	17	31	6	3	17	31	10	6	17	32	2	9
18	33	0	0	18	33	4	6	18	33	9	0	18	34	1	6
19	34	10	0	19	35	2	9	19	35	7	6	19	36	0	3
20	36	8	0	20	37	1	0	20	37	6	0	20	37	11	0
21	38	6	0	21	38	11	3	21	39	4	6	21	39	9	9
22	40	4	0	22	40	9	6	22	41	3	0	22	41	8	6
23	42	2	0	23	42	7	9	23	43	1	6	23	43	7	3
24	44	0	0	24	44	6	0	24	45	0	0	24	45	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	10	0	1	0	1	10	3	1	0	1	10	6	1	0	1	10	9
2	0	3	8	0	2	0	3	8	6	2	0	3	9	0	2	0	3	9	6
3	0	5	6	0	3	0	5	6	9	3	0	5	7	6	3	0	5	8	3
4	0	7	4	0	4	0	7	5	0	4	0	7	6	0	4	0	7	7	0
5	0	9	2	0	5	0	9	3	3	5	0	9	4	6	5	0	9	5	9
6	0	11	0	0	6	0	11	1	6	6	0	11	3	0	6	0	11	4	6
7	1	0	10	0	7	1	0	11	9	7	1	1	1	6	7	1	1	3	3
8	1	2	8	0	8	1	2	10	0	8	1	3	0	0	8	1	3	2	0
9	1	4	6	0	9	1	4	8	3	9	1	4	10	6	9	1	5	0	9
10	1	6	4	0	10	1	6	6	6	10	1	6	9	0	10	1	6	11	6
11	1	8	2	0	11	1	8	4	9	11	1	8	7	6	11	1	8	10	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	5	6	0	¼	0	5	6	9	¼	0	5	7	6	¼	0	5	8	3
½	0	11	0	0	½	0	11	1	6	½	0	11	3	0	½	0	11	4	6
¾	1	4	6	0	¾	1	4	8	3	¾	1	4	10	6	¾	1	5	0	9

Ft. long	23 *in. broad.*			Ft. long	23¼ *in. broad.*			Ft. long	23½ *in. broad.*			Ft. long	23¾ *in. broad.*		
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.
1	1	11	0	1	1	11	3	1	1	11	6	1	1	11	9
2	3	10	0	2	3	10	6	2	3	11	0	2	3	11	6
3	5	9	0	3	5	9	9	3	5	10	6	3	5	11	3
4	7	8	0	4	7	9	0	4	7	10	0	4	7	11	0
5	9	7	0	5	9	8	3	5	9	9	6	5	9	10	9
6	11	6	0	6	11	7	6	6	11	9	0	6	11	10	6
7	13	5	0	7	13	6	9	7	13	8	6	7	13	10	3
8	15	4	0	8	15	6	0	8	15	8	0	8	15	10	0
9	17	3	0	9	17	5	3	9	17	7	6	9	17	9	9
10	19	2	0	10	19	4	6	10	19	7	0	10	19	9	6
11	21	1	0	11	21	3	9	11	21	6	6	11	21	9	3
12	23	0	0	12	23	3	0	12	23	6	0	12	23	9	0
13	24	11	0	13	25	2	3	13	25	5	6	13	25	8	9
14	26	10	0	14	27	1	6	14	27	5	0	14	27	8	6
15	28	9	0	15	29	0	9	15	29	4	6	15	29	8	3
16	30	8	0	16	31	0	0	16	31	4	0	16	31	8	0
17	32	7	0	17	32	11	3	17	33	3	6	17	33	7	9
18	34	6	0	18	34	10	6	18	35	3	0	18	35	7	6
19	36	5	0	19	36	9	9	19	37	2	6	19	37	7	3
20	38	4	0	20	38	9	0	20	39	2	0	20	39	7	0
21	40	3	0	21	40	8	3	21	41	1	6	21	41	6	9
22	42	2	0	22	42	7	6	22	43	1	0	22	43	6	6
23	44	1	0	23	44	6	9	23	45	0	6	23	45	6	3
24	46	0	0	24	46	6	0	24	47	0	0	24	47	6	0

In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.	In. long	Ft.	In.	Pa.	S.
1	0	1	11	0	1	0	1	11	3	1	0	1	11	6	1	0	1	11	9
2	0	3	10	0	2	0	3	10	6	2	0	3	11	0	2	0	3	11	6
3	0	5	9	0	3	0	5	9	9	3	0	5	10	6	3	0	5	11	3
4	0	7	8	0	4	0	7	9	0	4	0	7	10	0	4	0	7	11	0
5	0	9	7	0	5	0	9	8	3	5	0	9	9	6	5	0	9	10	9
6	0	11	6	0	6	0	11	7	6	6	0	11	9	0	6	0	11	10	6
7	1	1	5	0	7	1	1	6	9	7	1	1	8	6	7	1	1	10	3
8	1	3	4	0	8	1	3	6	0	8	1	3	8	0	8	1	3	10	0
9	1	5	3	0	9	1	5	5	3	9	1	5	7	6	9	1	5	9	9
10	1	7	2	0	10	1	7	4	6	10	1	7	7	0	10	1	7	9	6
11	1	9	1	0	11	1	9	3	9	11	1	9	6	6	11	1	9	9	3

Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.	Qrs. in. long	In.	Pa.	S.	T.
¼	0	5	9	0	¼	0	5	9	9	¼	0	5	10	6	¼	0	5	11	3
½	0	11	6	0	½	0	11	7	6	½	0	11	9	0	½	0	11	10	6
¾	1	5	3	0	¾	1	5	5	3	¾	1	5	7	6	¾	1	5	9	9

Feet long.	24 *in. broad.*			*Feet long.*	24 *in. broad.*			*Inch long.*	24 *in. broad.*				*Qrs. in. long.*	24 *in. broad.*			
	Ft.	In.	Pa.		Ft.	In.	Pa.		Ft.	In.	Pa.	S.		In.	Pa.	S.	T.
1	2	0	0	13	26	0	0	1	0	2	0	0	¼	0	6	0	0
2	4	0	0	14	28	0	0	2	0	4	0	0	½	1	0	0	0
3	6	0	0	15	30	0	0	3	0	6	0	0	¾	1	6	0	0
4	8	0	0	16	32	0	0	4	0	8	0	0	...		...		
5	10	0	0	17	34	0	0	5	0	10	0	0	...		...		
6	12	0	0	18	36	0	0	6	1	0	0	0	...		...		
7	14	0	0	19	38	0	0	7	1	2	0	0	...		...		
8	16	0	0	20	40	0	0	8	1	4	0	0	...		...		
9	18	0	0	21	42	0	0	9	1	6	0	0	...		...		
10	20	0	0	22	44	0	0	10	1	8	0	0	...		...		
11	22	0	0	23	46	0	0	11	1	10	0	0	...		...		
12	24	0	0	24	48	0	0	...		...			...		...		

TABLE V.

AREAS AND CIRCUMFERENCES OF CIRCLES.

By this Table the area and circumference of a circle of given diameter can be found, AT SIGHT, and also the area of the square described upon the diameter.

The first column contains the diameter in inches, feet, or yards, from 1 to 10, increasing by quarters. The second column gives the square of the numbers in the first column, expressed in decimals. The third and fourth columns give the area of the circle whose diameter is found in the first column, expressed in decimals and duodecimals. The fifth and sixth columns give the circumference of the circle whose diameter is found in the first column, expressed in decimals and duodecimals.

If the diameter is given in feet, the column for the areas of circles gives the cubical content of a cylinder 1 ft. high, having the said diameter; so that, to find the cubical content of a cylinder of any other height, the number in that column must be multiplied by the given height; if the diameter is in feet, then the height must be expressed in feet also, and the content will be obtained in cubic feet.

Example.—To find the quantity of earth excavated from a circular cesspool $4\frac{3}{4}$ ft. in diameter, and 7 ft. deep. The area opposite to $4\frac{3}{4}$ is 17. 8. 8., which,

multiplied by 7, gives 124. 0. 8. cubic ft. of earth excavated. To find the superficial area of the brickwork required to surround the above cesspool; opposite 4¾ the circumference is 14. 11. 1., which, being multiplied by 7, gives 104. 5. 7. superficial ft. of brickwork.

Diamr. of Circle	Square of Diamr.	Area of Circle		Circumference of Circle	
		Decimals	Duodecimals	Decimals	Duodecimals
1	1·000	·7854	0 9 5	3·1416	3 1 8
1¼	1·563	1·2272	1 2 9	3·9270	3 11 1
1½	2·250	1·7671	1 9 2	4·7124	4 8 7
1¾	3·063	2·4053	2 4 10	5·4978	5 6 0
2	4·000	3·1416	3 1 8	6·2832	6 3 4
2¼	5·062	3·9761	3 11 9	7·0686	7 0 10
2½	6·250	4·9087	4 10 8	7·8540	7 10 3
2¾	7·562	5·9396	5 11 3	8·6394	8 7 8
3	9·000	7·0686	7 0 10	9·4248	9 5 1
3¼	10·563	8·2958	8 3 7	10·2102	10 2 6
3½	12·250	9·6211	9 7 5	10·9956	10 11 11
3¾	14·062	11·0447	11 0 6	11·7810	11 9 4
4	16·000	12·5664	12 6 10	12·5664	12 6 10
4¼	18·063	14·1863	14 2 3	13·3518	13 4 3
4½	20·250	15·9043	15 10 10	14·1372	14 1 8
4¾	22·562	17·7205	17 8 8	14·9226	14 11 1
5	25·000	19·6350	19 7 7	15·7080	15 8 6
5¼	27·563	21·6475	21 7 9	16·4934	16 5 11
5½	30·250	23·7583	23 9 1	17·2789	17 3 4
5¾	33·063	25·9672	25 11 7	18·0642	18 0 9
6	36·000	28·2743	28 3 3	18·8496	18 10 2
6¼	39·063	30·6796	30 8 2	19·6350	19 7 7
6½	42·250	33·1831	33 2 2	20·4204	20 5 0
6¾	45·562	35·7847	35 9 5	21·2058	21 2 5
7	49·000	38·4845	38 5 10	21·9911	21 11 10
7¼	52·563	41·2825	41 3 5	22·7765	22 9 4
7½	56·250	44·1786	44 2 2	23·5619	23 6 8
7¾	60·061	47·1730	47 2 1	24·3473	24 4 2
8	64·000	50·2655	50 3 4	25·1327	25 1 8
8¼	68·061	53·4562	53 5 6	25·9181	25 11 0
8½	72·250	56·7450	56 8 11	26·7035	26 8 6
8¾	76·563	60·1320	60 1 7	27·4889	27 5 10
9	81·000	63·6173	63 7 6	28·2743	28 3 4
9¼	85·562	67·2006	67 2 5	29·0597	29 0 9
9½	90·250	70·8822	70 10 7	29·8451	29 10 2
9¾	95·060	74·6619	74 7 11	30·6305	30 7 7
10	100·000	78·5398	78 6 4	31·4159	31 5 0

CHAPTER II.

EXCAVATING AND WELL-SINKING.

EXCAVATING.

Before a building can be commenced, it is necessary to dig out the ground to form *trenches* in which the foundations can be laid on as solid a basis as possible; also to excavate the ground for the basement story or cellars, and to dig trenches in which to lay the drains.

Where the excavation has to be carried down to a considerable depth, ground of various degrees of hardness will be met with, and separate items must be made of the different qualities of material excavated. The labour of digging and *throwing-out* will also increase with the depth, and a separate price is charged for every additional *throw* of 5 or 6 ft. of depth.

In measuring Digging, take first the basement story or cellars, which is stated as digging and throwing-out, or wheeling away; next the excavations to the trenches for footings of walls, and for the drains, cesspools, and well-sinking.

It is customary, in taking the digging to footings of walls, to allow about six inches on each side, over and above the width of the footings, for room to work

them; but if they are deep, and the ground bad and loose, allow nine inches on each side on account of its falling in. In sunk stories, only allow to the extent of the footings, except in very loose ground. In measuring trenches for concrete foundations, they may be taken the *nett* width of the concrete. Trenches for drain-pipes or brick drains must be at least 12 inches wider than the drains themselves.

In taking the dimensions, the length, depth, and width must be measured as before described, and reduced to the cubical yard of 27 cubical feet; namely, 3 ft. by 3 ft. by 3 ft. This quantity of 27 cubical feet is called a single load, and contains 21 striked bushels. Two cubic yards equal one double load.

In estimating excavators' work, it is advisable to keep the wheeling, carting, filling-in, and ramming to foundations and drains, separate from the actual digging and throwing-out; also the digging to the basement and cellars, drains, foundations, cesspools, wells, &c., under separate items.

The amount of digging which a man can perform in a day depends so much on the nature of the soil on which he has to operate, that it is almost impossible to fix a constant for this description of labour. The following data may, however, serve as a slight guide:—

In loose ground a man will throw up about ten cubic yards per day; but in hard or gravelly soils, where *hacking* with the *pick* is necessary, from three to five cubic yards, according to the hardness of the ground, will be a fair day's work.

Filling into Barrows and Wheeling is estimated by the *run* of 20 yards; an additional charge being made for every 20 yards beyond the first run. A gang of three men, two for filling and one for wheeling, will remove about 30 yards per day to the distance of one *run*; and the labour of removing earth may be calculated according to distance, allowing three men to the first run, and an additional man for every 20 yards of extra distance.

Therefore, to find the price of wheeling any number of cubic yards to any given distance, we have the following rule:—Divide the distance in yards by 20, which gives the number of wheelers; add the two cutters to the quotient, which gives the whole number employed; and the sum, multiplied by the rate of wages per diem, is the price of 30 cubic yards; so that, as 30 cubic yards is to the whole number of yards, so is the price of 30 yards to the entire cost.

Filling into Carts and Carting away is estimated by the *mile* of distance from the work; an additional charge being made for every additional mile beyond the first.

In excavating trenches of great depth in loose earth, it is often necessary to employ *planking* and *strutting*, to keep the ground from falling in, the cost of which must be added to the price for the digging; or it may be measured separately at per foot run, describing the average depth.

A cubic yard of earth in its original position, *before* excavation, will occupy from $1\frac{1}{4}$ to $1\frac{1}{2}$ cubic yards of space *after* being excavated; but it will subside into

nearly its original bulk when formed into embankments.

The following table gives the average bulk of one ton weight of different kinds of earth:—

21½	cubic feet of	sand	weigh one ton.
20½	„	gravel	„
19	„	clay	„
15½	„	chalk	„
18	„	night-soil	„

Night-soil is removed in carts containing 45 cubic feet or 2½ tons.

Claying or Puddling of Vaults, or clay tempered and laid over vaults about 6 in. in thickness, and puddled, is measured by the yard superficial of 9 square ft.; namely, 3 ft. by 3 ft., describing the thickness.

In measuring digging in Sideling Ground, where the areas of the two ends of the excavation are unequal, the cubic content must be found by the following rule:—

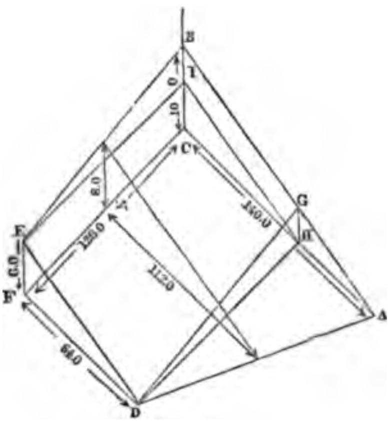
Multiply the sum of the extreme areas, plus four times the middle area, by one-sixth of the length, and the product will be the answer required.

Example.—To find the cubic content of the excavation A B C D E F for the sunk stories of a house to be built on the side of a hill:—

B G A D E represents the natural surface; and C H A D F the levelled surface, obtained by excavating to the depth of 10 ft. at B C, 6 ft. at E F, and nothing at D and A. The whole mass being regarded as a

frustum of an irregular pyramid, the triangles A B C and D E F are called the 'extreme areas;' and the

FIG. 9.



triangle N, half-way between and parallel with them, is the 'middle area.'

$\frac{CA \times BC}{2} = \frac{140 \times 10}{2} =$ 700 square feet in A B C.

$\frac{FD \times EF}{2} = \frac{84 \times 6}{2} =$ 252 square feet in D E F.

952 sum of extreme areas.

$4 \times \frac{112 \times 8}{2} =$ 1792 four times middle area N.

2744

$\frac{FC}{6} = \frac{120}{6} =$ 20 sixth of the length F C.

27) 54880 (2032 yards 16 feet.
54
88
81
70
54
16

As an illustration of the correctness of the rule, let us take the same example on a different principle

of measurement. The solid ABCDEF may be divided into the two prisms GHIBED and EFCIHD and the pyramid DAHG. Taking each of these separately, we have—

$$\text{Prism GHIBED} = \frac{84 \times 4 \times 120}{2} = 20160$$

$$\text{Prism EFCIHD} = \frac{120 \times 6 \times 84}{2} = 30240$$

$$\text{Pyramid DAHG} = \frac{56 \times 4}{2} \times \frac{120}{3} = 4480$$

Total ...... 54880 cubic ft.

or 2032 yds. 16 ft., as before.

WELL-SINKING.

The digging to Wells and Cesspools must be kept separate from all other excavations; and being circular, the quantity of earth excavated in each foot of depth can be found by multiplying the square of the half-diameter, in feet, by 22, and dividing the product by 7. The column in Table V. (p. 94) headed 'Area of Circle,' will also give the quantity of earth in 1 ft. of depth for any diameter from 1 ft. up to 10 ft.; and the cubical content for any depth is found by multiplying the quantity contained in 1 ft. of depth by the number of feet in the total depth of the well.

The excavation down to 30 ft. depth may be put under one item; but beyond that depth the cost increases, and an additional charge is made for every extra 30 ft. beyond the first. The nature of the soil

through which the well is sunk must also be taken into consideration.

DRY STEENING, is brickwork laid dry round wells, to keep the earth from falling in. This is generally charged with the digging of the well, at so much per foot of depth.

For deep wells sunk through loose soils, the brickwork is carried down along with it, a template being formed round the well on which the bricks are laid; and as the ground is dug away from underneath, the template is pushed downwards by the weight of the brickwork above, the top of which is always kept level with the surface of the ground.

BORING for water depends upon the nature of the soil or rock to be passed through; and the cost per foot of depth increases with every 10 ft.; that is, the price per foot for the second 10 ft. is double the price for the first 10 ft.; and for the third 10 ft. it is three times the price for the first 10 ft.; and so on, increasing in arithmetical proportion.

PUMPING water out of wells during the process of sinking is charged separately, by the gallon; there being $6\frac{1}{4}$ gallons in every cubic foot of water.

ROTATION

To be attended to in bringing the quantities into Bill.

EXCAVATOR, WELL-SINKER.

Yds.	ft.	in.				
			Cube of digging and throwing out loose stuff to basement story and cellars			
			Ditto, ditto, ditto, gravel, clay, or stiff stuff, to ditto, ditto, under 5 ft. in depth . . .			
			Ditto, ditto, ditto, above 5 ft. and under 10 ft. in depth . .			
			Ditto, ditto, ditto to trenches for foundations and drains, and ramming the bottom, including planking and strutting . .			
			Ditto filling in only and ramming to foundations and drains .			
			Ditto of wheeling — yds. distance.			
			Ditto carting away to a distance of — miles			
			Ditto digging only and throwing out to form well under 30 ft. deep			
			Ditto, ditto, ditto, ditto above 30 ft. deep			
			Superf. claying of vaults 6 in. in thickness			
			Run of well-sinking, including steening in half-a-brick, — ft. in diameter, under 30 ft. in depth .			
			Ditto, ditto, ditto steening in one-brick, — ft. in diameter, above 30 ft. in depth			
			Ditto of boring in clay, gravel (or other soil), including tools and tackle, with $3\frac{1}{2}$ in. auger; depth under 10 ft.			
			Ditto, ditto, ditto, ditto, depth above 10 ft.			

CHAPTER III.

BRICKWORK, CONCRETE, TILING, SLATING.

BRICKWORK.

The Bricklayers' work is the building of walls with bricks made of burnt clay, bedded and flushed-up with mortar or cement. The bricks used in this country are usually from 8½ in. to 9 in. long, 4 in. to 4½ in. wide, and about 2½ in. thick; although bricks of other dimensions are occasionally made for special purposes. The varieties of common bricks are *malms* or *marls*, *stocks*, and *place-bricks*. The *best malms* are selected as cutting bricks, for gauged arches, quoins, &c., and are rubbed to the required dimensions and gauge. The *seconds malms* are used for facing the fronts of buildings. *Stocks* are hard, rough-looking bricks, in which ashes have been mixed with the clay or loam used in their manufacture, capable of sustaining a great amount of pressure, and consequently are used for the principal walls of a building. *Place-bricks* are those which have not been thoroughly burnt, and are consequently soft and unfit to sustain heavy pressure or exposure to the weather; they are used for internal partitions, sleeper walls, &c., where great strength is not required. There are also *burrs*

or *clinker-bricks*, which have become vitrified by being too violently acted on by the fire, so that several bricks have run together into one mass. These are quite unfit for bricklayers' work, but are valuable for mixing with concrete, and also for road-making, as they possess great hardness. All these bricks are first dried in the sun upon rows called *hacks* and then burnt in *clamps*, the bricks being built up into a stack in the open air before being burnt, and a fire kindled in the centre. The superior kinds of brick are burnt in enclosed *kilns*, as *red facing* bricks, which owe their colour to the nature of the clay employed upon them; also *moulded* bricks, for forming string-courses, cornices, and other ornamental features in a building.

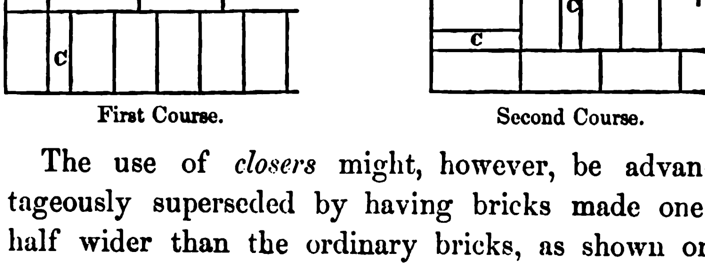
Bricks are termed FIRE-BRICKS when they are capable of resisting any amount of heat applied to them, and are consequently used for the linings of furnaces and furnace chimneys, the joints and beds being made with *fire-clay* instead of mortar or cement. PAVING-BRICKS or *Paviors* are made 1 inch thinner than common bricks, and are of a very hard texture finely tempered. There is also a smaller paving-brick of very hard character, which is of a much smaller size than ordinary bricks, and called a *clinker*.

The BEDS of brickwork are those joints which run in horizontal planes ; and a *course* is the whole layer of bricks comprised between two adjacent beds. In the erection of walls, when the bricks are laid longitudinally, or with their longest side parallel to the length of the wall, they are called *stretchers*; when

laid transversely, or with their longest side perpendicular to the face of the wall, they are called *headers*. Brick *bond* signifies the binding together of two adjacent bricks in the same course by one brick in the next course above pressing on both, or as it is termed, *breaking joint*.

BONDS are systematic modes of arranging bricks so as to insure breaking joint throughout the work. OLD ENGLISH BOND is the term given to brickwork in which *stretchers* only are laid in one course, and *headers* in the next above; and in like manner, headers and stretchers in each alternate course; in which case it is requisite to place quarter-bricks to break the joints at the external angles of the wall; when these are introduced they are termed *closers*. The method of laying two consecutive courses of a 14 in. wall in English bond is shown on figure 10, and the *closers* are marked with the letter C.

FIG. 10.—ENGLISH BOND.

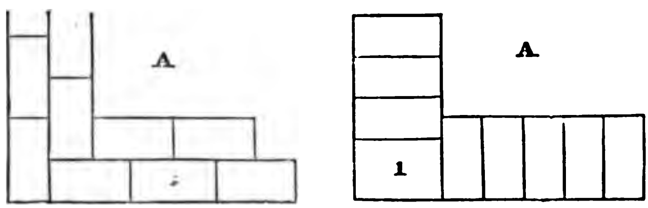


First Course. Second Course.

The use of *closers* might, however, be advantageously superseded by having bricks made one-half wider than the ordinary bricks, as shown on

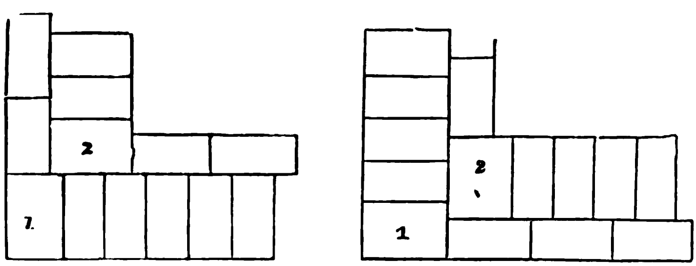
figures 11, 12, and 13, and marked with the numbers 1, 2, and 3.

FIG. 11.—ENGLISH BOND.—NINE-INCH WALL.



First Course. Second Course.

FIG. 12.—ENGLISH BOND.—FOURTEEN-INCH WALL.



First Course. Second Course.

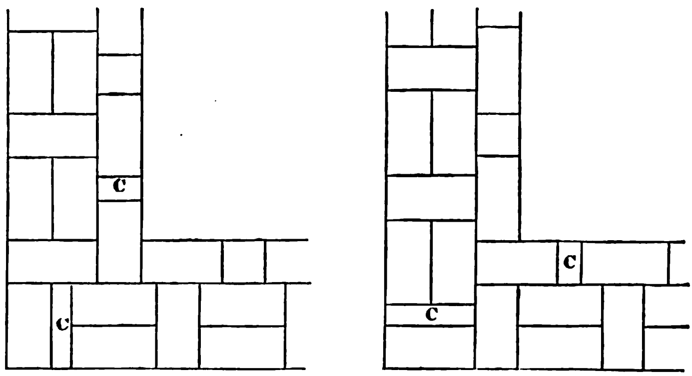
FIG. 13.—ENGLISH BOND.—EIGHTEEN-INCH WALL.

First Course. Second Course.

FLEMISH BOND is the term applied to brickwork in which *headers* and *stretchers* are placed alternately in

each course, as shown for a 14 in. wall in figure 14, the *closers* required to break the joints being marked with the letter C.

FIG. 14.—FLEMISH BOND.



First Course. Second Course.

This disposition of the bricks is not so strong as the English bond, and also requires more labour to execute. The *closers* might be dispensed with in the manner described for *English* bond (figs. 11, 12, 13,) by using wider bricks, made especially for the purpose.

From the size which bricks are usually made, it follows that the thickness of brick walls must always be a multiple of $4\frac{1}{2}$ in.; thus we have a 9 in. wall; a $13\frac{1}{2}$ in. wall (commonly called a 14 in. wall); an 18 in. wall; a $22\frac{1}{2}$ in. wall; a 27 in. wall; and so on. They are also named according to the number of bricks (in length) which compose their thickness. Thus a 9 in. wall is called a *one-brick* wall; a 14 in. wall a *brick-and-a-half* wall; an 18 in. wall a *two-brick* wall; a $22\frac{1}{2}$ in. wall a *two-and-a-half* brick wall; and so forth.

The following is the thickness of external and party brick walls, required by Act of Parliament for buildings erected in London and its suburbs, and may be generally taken as the *minimum* thickness which can with safety be employed in any building in which brick is employed:—

In Dwelling Houses, where any external or party wall is less than 25 ft. high and under 30 ft. long, it must be at least 8½ in., or 1 brick in thickness; and where the length of such a wall is greater than 30 ft., the part below the topmost story must be 13 in., or 1½ brick in thickness, and the upper part 8½ in.

When the height is under 30 feet, and the length less than 35 ft., the wall below the two upper stories must be 13 in. thick, and the rest 8½ in. thick; if the length exceeds 35 ft., the whole wall below the topmost story must be 13 in., and the remainder 8½ in.

When the height is under 40 ft., and the length less than 35 ft., the thickness of the wall is regulated as in the last case; but when the length exceeds 35 ft., the wall of the lowest story must be 17½ in., or 2 bricks thick, the rest of the wall below the top story 13 in., and the remainder 8½ in.

When the height is under 50 ft., and the length not more than 30 ft., the thickness of the wall below the top story is 13 in., and the rest 8½ in.; if the wall is not more than 45 ft. long, the thickness of the lowest story is 17½ in., the rest below the top story 13 in., and the remainder 8½ in. For greater length of wall, the lowest story must have walls 21½ in., or

2½ bricks thick; the next story 17½ in., and the remainder 13 in.

When the height is under 60 ft., and the length not more than 30 ft., the lowest story must have walls 17½ in. thick, the rest being 13 in.; if the length is under 50 ft., the two lowest stories must have 17½ in. walls, the rest being 13 in.; if the length exceeds 50 ft., the lowest story must have 21½ in. walls, the two next stories 17½ in., and the rest 13 in.

In walls up to 70 ft. feet high, having a length not exceeding 40 ft., the thickness must be 17½ in. in the two lower stories, the rest being 13 in.; if the length is under 55 ft., the lowest story must have 21½ in. walls; the two next stories 17½ in., and the rest 13 in. For a greater length of wall, the lowest story must have 26 in., or 3-brick walls, the two next 21½ in., the next story 17½ in., and the rest 13 in.

Walls under 80 ft. in height, with a length of 40 ft., must have 21½ in. thickness in the lowest story, 17½ in. in the two next stories, and 13 in. for the remainder; if under 60 ft. long, the two lower stories must have 21½ in. walls, the two next stories 17½ in., and the remainder 13 in. For greater length, the lowest story must have 26 in. walls, the two next 21½ in., the two next 17½ in., and the remainder 13 in.

In walls up to 90 ft. in height, the length being under 45 ft., the thickness of the two lower stories must be 21½ in., of the two next 17½ in., and of the remainder 13 in. Where the length is under 70 ft., the thickness in the lowest story must be 26 in., in

the two next 21½ in., in the two next 17½ in., and the remainder 13 in. If of greater length, the thickness of the lowest story must be 30 in., or 3½ bricks, of the two next stories 26 in., of the next story 21½ in., of the two next stories 17½ in., and of the remainder 13 in.

In walls up to 100 ft. high, having a length not exceeding 45 ft., the two lowest stories must have 21½ in. thickness, the three next 17½ in., and the remainder 13 in. If the length is not more than 80 ft., the two lowest stories must have 26 in. walls, the two next 21½ in., the two next 17½ in., and the rest 13 in. If of greater length than 80 ft., the walls in the lowest story must be 30 in., in the two next 26 in., in the two next 21½ in., in the two next 17½ in., and the remainder 13 in.

In Warehouses, Factories, &c., the thickness of the external and party walls, which do not exceed 25 ft. in height, must be 13 in. at the base. If the height is under 30 ft., and the length not more than 45 ft., the walls must be 13 in. at the base; but if more than 45 ft. long, 17½ in. at the base. In walls not more than 30 ft. high, the thickness of the top story may be 8½ in.; but in all other walls of greater height than 30 ft., the thickness at the top and for 16 ft. down must be 13 in.

When the height is under 40 ft., and the length under 30 ft., the thickness at base must be 13 in.; if the length is under 60 ft., the thickness at base is 17½ in.; and for a greater length, 21½ in. With the height under 50 ft., and length under 40 ft., the base

must be 17½ in.; if the length is under 70 ft., the base must be 21½ in.; and for greater length, 26 in. When the wall is under 60 ft. high, and its length not more than 35 ft., the thickness at base must be 17½ in.; if under 50 ft. long, 21½ in.; if of greater length, 26 in.

Where the height of a wall is under 70 ft., and its length not more than 30 ft., the base must be 17½ in. thick; if the length is not more than 45 ft., the base must be 21½ in.; and for greater lengths, 26 in.

If the height is under 80 ft., the length not exceeding 45 ft., the base must be 21½ in. thick. Where the length is under 60 ft., the base must be 26 in.; and for greater lengths, 30 in.

For walls up to 90 ft. high, whose length is not more than 60 ft., the base must be 26 in. thick; if the length is under 70 ft., the base must be 30 in.; and for any greater length, 34 in., or 4 bricks.

Where the height of the wall is not more than 100 ft., the length being under 55 ft., the base must be 26 in. thick. If the length is under 70 ft., the base must be 30 in.; and for any greater lengths, 34 in.

Flues for chimneys are generally built 14 in. by 9 in. on plan, having a solid *withe* of at least 4½ in. of brickwork between them; and no woodwork should be placed in a wall nearer than 12 in. from the inside of a chimney flue.

Flues must never be made with sharp angles in them, as the soot is liable to accumulate at such points; the angle which one part of a flue makes with

another should never be less than 130°, and properly rounded off. If sharper angles are introduced, iron soot doors must be placed at them, so that the soot can be readily removed.

PARTY-WALLS are those which are carried up between two adjoining houses, so as to form a complete separation between them, and to prevent the spread of fire from one house to another. The Building Act requires that party-walls shall be of the same thickness as the external walls, and shall be carried 15 in. high above the roofs, measured at right angles to the slope. No timbers are to come within 4½ in. of the centre of a party-wall; but bond-timbers and wooden plates are not permitted to be laid therein at all.

A CROSS-WALL is one that is built as a separation of one part of any building from another part thereof.

The FLANK-WALLS of a detached house are those which join the back and front walls together.

BATTERING is sloping the face of a wall inwards from the base towards the top. In brick walls it is measured as extra per foot superficial.

In very thick walls a variety of bond called *herring-bone* is occasionally used. This is formed by a course of stretchers at each face of the wall, filled in with bricks laid diagonally. The wall is then continued again for another course, and the filling-in bricks are laid diagonally, the reverse way of the previous one.

FOOTINGS are all such foundation courses as are wider than the body of the wall above; and being all centrally over each other, and diminishing from the

base upwards by half-a-brick, or $4\frac{1}{2}$ in. at a time, they can only leave steps, or *offsets*, of a quarter-brick on each side. See fig. K, Plate 1.

The object of the footings is to distribute the weight over as large a surface of the ground as possible, so as to avoid unequal settlements in the building. The projection of the bottom of the footings at each side must be at least one-half the thickness of the wall.

DAMP-PROOF-COURSE. In order to prevent the damp from rising from the soil through the brick walls, it is usual to put a layer of some impervious material above the footings, over the whole thickness of the wall. A coating of asphalte, gas-tar and ashes, or a double course of slates bedded in cement, are the materials most commonly used for this purpose. Perforated glazed bricks have also been manufactured especially to prevent the damp from rising, and at the same time to introduce a current of air under the lowest floor of the building.

HOLLOW-WALLS are walls built with an outer and inner casing, a cavity of 2 or 3 in. being left in the middle, so as to prevent weather from driving through. The two parts are tied together either with occasional headers, or with pieces of slate, or with iron straps made for the purpose. This method of building is common in exposed situations.

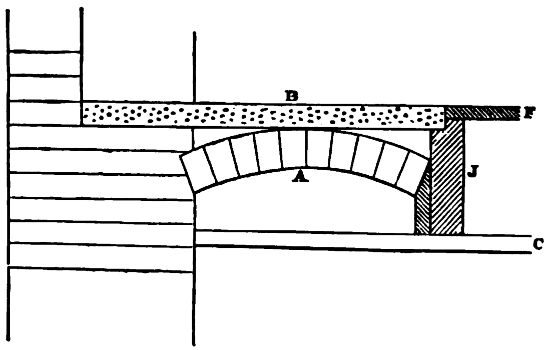
SLEEPER-WALLS are those which are built at intervals across the basement, to carry the timbers of the lowest floor.

FENDER-WALLS are those which are built round the

fire-places of rooms on the lowest floor, to carry the stone slabs or hearths.

TRIMMER-ARCHES are those which are built to carry the hearths of the fireplaces in the upper stories, as shown on fig. 15. The brick trimmer-arch A is

FIG. 15.



thrown across from the wall to the trimmer-joist J, on which a skew-fillet is nailed to receive the arch; B is the hearth resting upon the arch, F the floor, C the ceiling of room below. The object of this arch is to prevent hot ashes from getting between the joints of the stone hearth, and setting fire to the floor or ceiling. Trimmer-arches are measured by the foot superficial. An iron tie-rod is sometimes introduced to prevent the arch from thrusting out the wooden trimmer. Instead of an arch, a layer of Portland cement concrete 3 or 4 in. thick will serve the purpose of carrying the hearth.

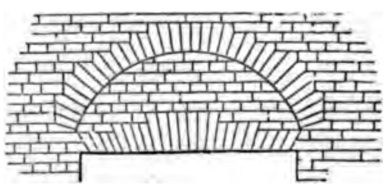
INVERTS are arches inverted or turned upside-down, and built in the wall under the openings on the lowest story, in order to distribute the pressure

of the piers equally over the whole length of the foundations.

PARGETTING is plastering the inside of chimney-flues with mortar in which cow-dung is mixed, so as to make a smooth and even surface throughout, the admixture of cow-dung increasing the power of resistance to the action of heat. The flues are afterwards *cored* by a chimney-sweep, to clear out any projections or obstructions.

GAUGED-WORK is when bricks are cut and rubbed upon a piece of stone to a particular *gauge* or size, as for arches over windows or other openings (fig. 16), and set with fine or *putty* mortar.

FIG. 16.



SKEW-BACKS are the inclined surfaces necessary to receive the ends of any arch that makes angles with its supports, as in a straight or a segmental arch. See fig. G, Plate 1; also fig. 16, above.

A CHASE is a vertical channel cut or left in a wall to receive pipes, &c., which it is desired to bury therein. When it is intended to build one wall against another, a chase is sometimes left in the wall first erected, into which the other is afterwards built, forming a plumb-joint the whole height thereof. By the Building Act it is provided that no chase in a *party-wall* shall exceed 14 in. in width, or 4½ in. in

depth, nor be nearer than 7 ft. to any other chase in the same side of the wall.

BIRD'S-MOUTH is any re-entering angle that requires the bricks to be notched. See fig. o, Plate 1.

REVEALS of windows are the sides or surfaces receding from the outer face of a wall, back to the window-frame, and are at least 4½ in. deep.

WALL-PLATES are the horizontal timbers laid by the carpenter in the wall during its erection to receive the ends of the floor-joists, and to distribute their weight uniformly over its whole length.

BOND-TIMBER is timber laid by the carpenter horizontally in the wall during its erection, the thickness of one course of bricks, to tie the work together. Bond-timber is now generally discarded, except for internal brick partitions, on account of its being liable to shrink and decay, and thereby weakening the wall it is intended to strengthen.

IRON-HOOPING is generally used in place of bond-timber for external and party-walls, and bedded in cement.

DRY-STEENING is brickwork laid dry round wells and cesspools, to keep the ground from falling in, as described under Well-sinking (p. 101).

POINTING is the filling-up with mortar or cement of the joints of the brickwork on the face, after the wall is built, the mortar in the joints being previously raked out before the pointing is laid in. It is measured by the foot superficial, including in the price quoted, the labour, mortar, and scaffolding.

Flat-joint pointing is when the mortar in the joints

of a brick wall is raked out and filled in again with blue mortar, and the courses are marked with the edge of the trowel.

Tuck-pointing, formerly called *tuck and pat*, is when, in addition to the above flat-joint pointing, plaster or fine mortar is inserted in the joints, with a regular projection, and neatly pared to a parallel width.

Striking the joints is finishing off the mortar joints with the trowel as the work proceeds; it is adopted for inside work when the walls are not intended to be plastered, or are only to be lime-whitened.

OUTSIDE SPLAYS to openings in brick walls, are cut and rubbed to show fair. See fig. Q, Plate 1.

INSIDE SPLAYS to openings in walls, are only rough cut to batten or plaster against. See fig. P, Plate 1.

BRICK-NOGGING is the term applied to a partition constructed with a row of posts or quarters, disposed at 3 ft. apart, and the intervals filled up with brick-work. A partition of this kind is usually 4½ in. thick, or the breadth of a brick.

CHIMNEY-BREAST is that portion of the wall above the chimney opening which projects out into the room, when the wall is too thin to contain the flues.

UNDERPINNING is the cutting away and rebuilding the foundations of an old wall which is in an insecure condition, or which it is required to take down to a lower level. It is a process which requires the greatest care, and only a small portion of the wall must be removed at a time, which is at once filled in with the new work bedded in cement.

BRICK-PAVING is done with stocks, malms, paviors,

or clinkers; these are either laid flat or on edge in sand, mortar, or cement, the ground being previously prepared and levelled, or concrete laid.

GROUTING is liquid lime and sand poured into brickwork or over paving, to fill up the interstices in the joints and bind the whole together. The cost of it is included in that of the work that is grouted.

CONCRETE is a kind of artificial stone or rock made by mixing unslacked lime or cement with gravel or broken-stone and sand, a sufficient quantity of water being added to slack the lime. It is thrown while moist into the trenches for the foundations, and in a few days hardens into a solid mass. By means of concrete, buildings may safely be erected on the softest and most yielding soils, as the weight is uniformly distributed over a large area; and if any settling takes place, the whole building settles uniformly throughout.

Lime-concrete is made of ground stone lime, and sharp gravel, with a proper quantity of sharp sand, mixed in the proportion of five or six parts of gravel and sand to one of lime, according to the nature of the lime and the proportion of sand mixed with the gravel. Its quality is much improved by the addition of smiths' ashes, or any material containing iron; and for this reason ferruginous gravel is to be preferred whenever it can be obtained. Concrete made with lime expands slightly in slaking; but this expansion is too trifling to be taken into account in framing an estimate. A cubic yard of concrete, containing 27 cub. ft. when mixed, requires 34 cub. ft.

of gravel, sand, and lime: therefore, at the proportion of six of gravel to one of lime, a cub. yard of concrete will require 1·1 cub. yard of gravel and sand, and three bushels of lime.

Cement-concrete is made with *Portland* cement instead of lime, in the proportion of one part cement to seven or eight parts of gravel and sand; care must be taken that the sand and gravel are perfectly free from earthy particles, and the coarser the sand the better. Only a small quantity must be mixed at once, as it sets rapidly. Cement-concrete contracts slightly in setting.

It is usual to measure concrete, when used in considerable quantities and not less than 12 in. in thickness, by the cubic yard; but where the thickness is less than 12 in., it may be taken at the superficial yard, the thickness being stated.

Another kind of concrete which is suitable for making fire-proof floors is composed of *sulphate* of lime mixed with broken bricks, calcined cinders, and other porous material. When used for floors or ceilings the soffit is slightly arched, a rise of 1 in 12 being the *least* that is given to the curved soffit, the spandrils may be filled up so as to form a level surface or floor on the top. When the arch is of the minimum rise a span of 6 to 8 ft. may be covered without any intermediate supports, the concrete being about 4 in. thick at the middle; for greater spans, wrought-iron joists or beams are employed to divide the span, and the concrete arches thrown across them. By giving a greater rise to the arch

much greater spans can be covered without intervening supports. The cost of this material is valued by the superficial yard, exclusive of iron work, centerings, or scaffolding.

An Artificial or Concrete-stone may be also formed in the following manner: mix finely sifted dry sand with a small proportion of pulverised stone or carbonate of lime, then add a solution of a material called the *silicate of soda*, which is obtained by boiling flints in a solution of caustic soda; one gallon of this silicate is mixed in a mill with every bushel of the first-named mixture of sand and powdered stone, and the mass is put into moulds of the required form, well rammed, and allowed to harden; the blocks, on being turned out of the moulds, are saturated with a solution of the *chloride of calcium* obtained by dissolving lime in muriatic acid, by which means the silicate of soda is changed into the silicate of lime, and a deposit of common salt left on the surface, which is washed off with water. The crushing strength of this material depends very much upon the materials used in its composition.

Retaining-walls are those which are built for the purpose of supporting embankments of earth, so that they have to resist the pressure which the earth exerts in endeavouring to assume its *natural slope.* The amount of this pressure will depend on the nature of the soil to be sustained, loose soil having a tendency to form a slope of lower inclination than firm earth or rock. The natural slope of loose earth, as sand or gravel, is about 30° with the

horizon, and that of stiff clay about 45°. In the former case, the thickness of the wall at its base must be about one-third of the height, and in the latter about one-fourth of the height; the face of the wall may be made to batter, so as to have the thickness at top about two-thirds that of the base. Retaining-walls should possess perfect cohesion throughout, and the best material for their construction is either stone in heavy blocks, or concrete of lime or cement and coarse gravel.

Terra-cotta is a building material closely allied to brick, clay being its principal component, and fire being employed to burn it into a condition fit for use. Clays of a peculiar kind, such as are found in Cornwall, Devon, Dorset, Northamptonshire, &c., are mixed with sand, ground glass, china-stone, fel-spar, and flint, &c., well pulverised. The red, buff, and white colours which belong to terra-cotta, are derived from the clays used in its manufacture. If other colours are required, they are obtained by mixing mineral pigments with the clay. When the clay is properly tempered, it can be moulded into any desired form, left to dry, and then burnt in a kiln. When a number of pieces of the same form, as in a moulded string-course, cornice, or other architectural feature, are required, it is usual to first make a model, and take a plaster mould therefrom, from which the clay is cast, dried, and burnt. When made in blocks of considerable size, it is cast hollow, so as to insure equal hardness and contraction throughout. The material contracts considerably both in drying and in

burning, which must be allowed for in preparing the original models. When terra-cotta is well made it is unaffected by exposure to weather, or to the acid gases found in a smoky atmosphere; it also preserves its colour better than stone or common brick. It weighs when solid about 122 lbs. per cubic foot, but being generally used hollow, it is much lighter than this. When used in long moulded courses, there is a difficulty in getting the pieces exactly to fit, the joints and surface of adjoining blocks often requiring to be rubbed down with sharp sand and water, in order to make them true. This defect, however, can in a great degree be avoided by care in the making, drying, and burning.

Some kinds of terra-cotta are made from the material called fire-clay, obtained in the neighbourhood of coal pits; this is ground to a fine powder, and mixed with a small quantity of old terra-cotta, also reduced to powder. Other sorts are made from a pure clay, which requires no admixture of any other mineral substance; this will stand any amount of heat that can be applied to it, and produces articles of the hardest description.

MEASUREMENT OF BRICKWORK.

The standard measure for brickwork in London is the rod of 16 ft. 6 in. sq., which dimension being multiplied into itself produces 272 ft. 3 in., but the odd 3 in. are never taken into account. It is therefore always considered as 272 superficial ft., at 1½

brick, or 13½ in. thick, or 306 ft. cube, viz., 272 ft. by 1 ft. 1½ in. All the other thicknesses are *reduced* to this standard, as shown hereafter in the manner of taking the dimensions and abstracting the work.

Brick walls of great thickness are generally measured by the cubic yard.

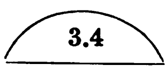
In measuring brickwork always begin with the foundations, then proceed with measuring each story separately (or as high as the wall continues of the same thickness), as solid work, according to their respective thicknesses; then add for all projections, as breasts of chimneys, &c., deducting the openings, but not the flues, as the extra trouble and the pargetting is deemed equivalent to the deficiency of materials; but deduct the openings of doors, windows, &c.

If the house or building be rectangular, measure two walls the whole length of the external face, and the other two internally, so as to get the true cubical contents.

But in measuring for labour only, the external face of the work is girt, and multiplied into the height and thickness, to pay for the extra labour of plumbing the angles, and working the returns fair.

In measuring walls that are faced with superior bricks, the walls are first measured as common work, and then the superficial quantity of facing is taken, as hereafter shown, and is valued by considering the facing as two-thirds of a brick thick, and deducting the common brickwork from the price thereof, the same thickness, viz., two-thirds of a brick; by which the value per foot superficial is ascertained.

In measuring circles, or semicircles, they are marked accordingly in the measuring-book. Thus:



or


with the diameters figured.

To measure angle chimneys, draw lines on the floor, parallel to the two sides of the room, cutting the parts intersected by the chimney, as shown in the plans, Plate 1; take either side by the height of the floor, and half the other (the work forming a triangle) for the thickness, either as the number of bricks, or as cube work, which, by the directions before given, and the example shown in the first chimney taken, proves it to be exactly the same: consequently, if the projection should not amount to any certain number of half-bricks, it would be best to take it as a cube dimension. In all cases it is supposed that the walls, as shown by the dotted lines, are measured before the projecting chimneys are taken, which is the usual custom.

In taking the dimensions of vaults, measure the abutments, or side walls, to the springing of the arch, then bend your rods round the soffit of the arch; and add once and a half the thickness thereof, by which you obtain the average girt of the arch; then take the length clear of the walls; but if the arch is turned over one or both walls, add the thickness thereof to the length of the arch. But in taking the height of the walls, measure to the crown of the arch, without making any deduction for the declivity of the arches, on account of the additional trouble and waste of bricks, in cutting and fitting them to the curved

soffit of the arch. Likewise, in deducting openings with circular heads, the dimensions should only be taken to the springing of the arches, on account of the trouble and waste of bricks in fitting them to the arches.

Brick drains of large size to be taken and reduced as common brickwork if built with mortar; ordinary house drains by the foot run, describing the form and size.

Pipe drains are measured by the foot run, and all bends, junctions, traps, &c., are numbered.

Shafts of chimneys are measured as solid work.

Ovens and coppers are measured as solid cube brickwork, deducting the ash-holes only.* Tiles and Welsh lumps, and fire bricks, are to be allowed as extras.

In these, or any other brickwork that it is considered best or most convenient to measure by the cubic foot, multiply the solidity by 8, the number of $1\frac{1}{2}$ in. in a foot, and divide it by 9, the number of $1\frac{1}{2}$ in. in $13\frac{1}{2}$ in., which will reduce it to the standard of $1\frac{1}{2}$ brick, or $13\frac{1}{2}$ in. in thickness.

In measuring brickwork no allowance is to be made in quantity for small or difficult works. Timbers inserted in the walls are not to be deducted. When plates are bedded in the walls, two inches to be allowed for ditto where no brickwork is over them. All sills and stone strings are measured in.

* This method is in common use amongst surveyors; but it would be far more consistent to measure the actual quantity of brickwork, allowing for the extra labour in price.

All cuttings to be measured superficial; as outside splays, cut and rubbed to show fair, or inside ditto rough cut for battens, &c. See Plate 1, figs. P and Q.

Birds'-mouths at per foot run, being notched to fit. See Plate 1, fig. O.

Facings of all descriptions to be measured extra by the foot superficial; in which case the reveals are also measured, except where intended to be stuccoed. All openings are to be deducted.

Gauged arches to doors, windows, &c., are also measured by the foot superficial, taking face and soffit.

Groins are measured as common work, only taking the run of cut groins at per foot.

Brick-nogging, by the yard square of 9 ft., including the timbers; all openings to be deducted.

Brick paving, ditto, ditto.

Fascias, beads and quirks, dentil or plain cornices, &c., measured and valued by the foot run.

Brick-on-edge coping, if set in cement, to be measured at per foot run, as *extra* to brick-on-edge in cement.

TILING.

TECHNICAL TERMS AND EXPLANATIONS.

Eaves are the lower horizontal edges of the tiling. They are called *dripping* eaves when they overhang the walls.

Hips are the inclined ridges, like those of a pyramid, formed by the meeting of two tiled surfaces rising from two walls that form a salient angle.

VALLEYS are the reverse of hips, being the inclined furrows, like those of a hollow inverted pyramid, formed by the meeting of two roof-faces over a re-entering angle of the plan. Wherever there is a re-entering angle, a valley is unavoidable, while a hip can occur only over a salient angle.

GABLE is the triangle formed by the roof-planes rising from two parallel walls, continued until they meet at right-angles a third or *gabled* wall.

PAN-TILING is a mode of covering a roof with tiles of a rectangular outline or plan, but having a surface both concave and convex, thus ; so that, as they lie side by side, one laps over the other, thereby forming a series of ridges and valleys, alternately running from the top to the bottom of the roof. Pan-tiles are hung on fir laths, which are nailed to the rafters, by means of a ledge formed in their making at their upper ends; and are usually 14 in. long, and 10 in. broad, weighing about 5 lbs. each. They are laid with a *gauge* of 11 or 11½ in.; that is, they show that amount between the bottom of one tile and the bottom of the next above or below, each tile lapping 2 or 3 in. over the one below it; 164 tiles cover one square of 100 superficial feet, when laid to 11-inch gauge.

PLAIN OR PLANE TILES are of a rectangular form, with a flat or plane surface; and are usually about 10½ in. long, 6 or 6½ in. broad, and five-eighths of an inch thick. Their weight is from 2 to 2½ lbs. each. Some are made to hang on to the laths with a ledge, as in pan-tiles, while others are made

with two holes drilled for nails or pegs. They are laid to a 4-inch *gauge*, with or without a bedding of mortar, 600 tiles covering one square of 100 ft. superficial.

TILE-CREASING, or WEATHERING, is two rows of plain tiles placed horizontally under the coping of a wall, and projecting about 3 in. therefrom, to discharge the rain-water. It is measured by the foot run.

HIP and RIDGE TILES are of various form and design, and are laid over the edges of the tiled surfaces of the roof, where they meet at a hip or ridge.

VALLEY-TILES are made of a semi-circular section, and are laid under the edges of the tiled surfaces, where they meet at a valley. Hip, ridge, and valley tiles are measured by the foot run.

ORNAMENTAL TILES are plain tiles made into various fancy patterns, and vary in size and design.

CEMENT FILLETTING is a luting of cement laid on the tiling where it meets a wall carried up above it. It is measured by the foot run.

Measurement.—Plain and pan-tiling to be measured by the square of 100 ft.

In measuring plain tiling—

Allow for the eaves 4 in. extra.
Ditto for dripping do. 6 in. extra.
Ditto for all cuttings, hips, &c., 3 in. extra.
Ditto for valleys, 12 in. extra.

In measuring pan tiling—

Allow for the barge per foot run.
Ditto for heading to barge per foot run.

Allow for cutting to hips and splays per foot run.

Ditto for hips and ridges per foot run.

Number the hip hooks, which should be painted three times in oil.

Ditto T nails, ditto.

Deduct for chimneys and skylights, and deduct and add for dormers.

If the roofs are hipped, take the length at the bottom of the sides, and not measure the end; the two side triangles being equal to the hipped end one.

In order to illustrate the principle of measuring bricklayers' and tilers' work, and bringing it into bill, in Plate 1 is given a plan, elevation, and section of the front wall of a house, with the windows to a larger scale, and also plans of different chimneys. The rules before stated are likewise explained, by showing the manner of taking the dimensions in the measuring-book, and the method of preparing the abstract, and entering them therein, together with other imaginary quantities, to make the particular manner of abstracting the work perfectly clear and explicit.

See the general rules under the head **Measuring**, viz.:—

Bricklayers' Work done for A. B., Esq., at his house, Kensington,
By C. D.

Measured January 1st, 1870, with Mr. E. F.

ft. in.	bks.	ft. in.			ft. in.
27 6 0 6	5	13 9	Brick footing, 2 bottom courses. 27 6 Figs. C and K.		26 0 front of house. 0 9 projec. of footings. 0 9 do. other end. 27 6
26 9 0 9	4	20 1	Do. average thickness of the courses above do. 80 4		26 0 0 9 ½ B. at each end. 26 9
26 0 9 0	3	234 0	B. W. above do. to under side of ground floor. 468 0		0 6 under floor. 8 6 height of story. 9 0
2)5 0 3 6	½	35 0	DDt. openings 17 6	Windows	5 0 0 4½ upper reveal. 5 4½
2)5 4½ 4 3	2½	45 8	DDt. reveals	Windows	3 6 0 9 2 side reveals. 4 3
2)4 3 3 6	2	29 9	DDt. backs 59 6	Windows	
7 6 3 6	½	26 3	DDt. openings 13 2	Door.	
7 10½ 4 3	2½	33 5	DDt. reveal.	Door.	
26 0 13 0	2½	338 0	Add B. W. to ground floor.		1 0 thickness of floor. 12 0 height of room to under side of one pair floor. 13 0
2)7 6 3 6	½	52 6	DDt. openings 17 6	Windows.	
2)7 10½ 4 3	2	66 11	DDt. reveals 133 10	Windows.	
2)4 3 2 6	1½	21 3	DDt. backs	Windows.	

ft. in.	bks.	ft. in.			
10 0 3 6	½	35 0	DDt. opening 17 6	Front door.	
10 4½ 4 3	2	44 1	DDt. reveal 88 2		
26 0 13 0	2	338 0	Add B. W. to one-pair floor. 676 0		ft. in. 1 0 thickness of floor. 12 0 height of room. 13 0
3)8 0 3 6	½	84 0	DDt. openings 28 0	Windows.	
3)8 4½ 4 3	1½	106 9	DDt. reveals		
3)4 3 2 3	1	28 8	DDt. backs		
26 0 9 11	1½	257 10	Two-pair floor, B. W. to under side of tie-beam.		
3)5 6 3 6	½	57 9	DDt. opening 19 3	Windows.	
3)5 10½ 4 3	1	74 11	DDt. reveal		
3)4 3 2 9	½	35 1	DDt. backs 17 7		
26 0 3 2	1	82 4	Add B. W. to parapet to under side of coping.		
			In making deductions for revealed windows, if the wall is only one brick thick, take one reveal in and one out as follows:		
5 8¼ 3 10½	1	22 0	DDt. upper windows, suppose wall only one brick, and the window openings of the annexed dimensions		5.6 3.6

Measuring Chimneys.

The height of the rooms supposed to be 10 feet.
Do. of the chimney-openings, 4 feet.

(See Plate No. 1.)

ft. in.	bks.	ft. in.	
10 0 4 6	3	45 0	B. W. to angle chimney. 90 0
4 0 3 6	2	14 0	DD$^{t.}$ opening. 28 0
10 0 4 6 2 3		101 3	Cube B. W. to angle chimney. I.
10 0 9 0	3	90 0	B. W. to angle chimney. L. 180 0
4 0 3 6	2	14 0	DD$^{t.}$ opening. 28 0
10 0 5 6	1	55 0	B. W. to chimney-breast. M.
4 0 3 6	2	14 0	DD$^{t.}$ opening. 28 0
10 0 4 9	5	47 6	B. W. to angle chimney. N. 95 0
10 0 4 0	2	40 0	DD$^{t.}$ B. W. angle.
4 0 3 6	2	14 0	DD$^{t.}$ opening. 108 0
		54 0	

ft.	in.
101	3
	8
9)810	0
90	0

This, though taken before, is entered again to show the manner of abstracting cube B. W. red. to 1½ br. th.

All gauged work is first measured in with the common brickwork, and afterwards taken at per foot superf. measured as follows:—

3 6 0 4	1 2	soffit to gauged arches.
3 10 1 0	3 10	face of ditto.

(See Plate 1, fig. G.)

ON ABSTRACTING.

In abstracting bricklayers' work, although it will be found advantageous, it is not so absolutely requisite to observe a regular rotation as in joiners' work. But particular attention is required in abstracting bricklayers' work, to place the contents of the dimensions, according to their different thicknesses, and the deductions thereon, so that they may be *reduced* to the proper standard or thickness (of one brick and a half, or thirteen and a half inches) in the abstract; which will be perfectly easy after considering the explanation given, and seeing the form of the following abstract:—

Place the cube brickwork in the first columns	One column for one brick thick. One do. for one and a half do.	Add.
	One do. for one brick thick One do. for one and a half do.	Dd.

By which method you may abstract brickwork to any thickness. Thus:—

If half a brick thick, one-half the quantity may be placed under the head of one brick, or one-third the quantity under the head of 1½ brick.

If two bricks in thickness, twice the quantity may be placed under the head of one brick.

If two and a half bricks in thickness, the same quantity must be placed under the head of one brick, and also under 1½ brick.

If three bricks in thickness, twice the quantity must be placed under the head of 1½ brick.

In this manner brick walls of all thicknesses may be abstracted under two heads, and thereby avoid having a column for every thickness of wall in the building.

Next proceed with the different descriptions of tilings, and all other work measured by the square of 100 feet.

Next, the pavings, brick-nogging, and other work measured by the yard square of nine feet.

Next, the work measured by the foot superficial; and next with the work measured by the foot run, as shown in the following abstract.

The following are imaginary dimensions, to explain the manner in which walls of any number of bricks in thickness may be abstracted under the two heads of one brick and one brick and a half. These being the general thicknesses of walls, it very seldom occurs that the walls are of the thicknesses here stated, which are only given to make the principle understood.

					To be abstracted as		
ft.	in.	bks.	ft.	in.	ft.	in.	bks.
5 2	6 3	½	12	4	6	2	1
7 5	6 8	1	42	6	42	6	1
10 6	3 9	1½	69	2	69	2	1½
8 6	6 2	2	52	5	104	10	1
10 4	0 6	2½	45	0	45 45	0 0	1½ 1
9 5	0 3	3	47	3	94	6	1½

					To be abstracted as		
ft.	in.	bks.	ft.	in.	ft.	in.	bks.
8 6	0 4	3½	50	8	50 101	8 4	1½ 1
7 3	6 9	4	28	1	112	4	1
12 3	6 8	4½	45	10	137	6	1½
10 5	6 2	5	54	3	271	3	1
8 3	4 9	5½	31	3	31 125	3 0	1½ 1
10 5	10 6	6	59	7	238	4	1½

Walls one brick thick are *reduced* to 1½ brick by multiplying their area by 2 and dividing by 3.

Abstract arranged as before stated.

ABSTRACT OF BRICKLAYERS' WORK done for A. B. by X. Y.

Abstracted with Z. January 1, 1870.

RODS.															
Cube B. W.				Superficial B. W.											
Add.		DDt.		Add.				DDt.							
				1 Bk.		1½ Bk.		1 Bk.		1½ Bk.					
ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.				
101	3			27	6	27	6	17	6	45	8				
				80	4	468	0	45	8	33	5				
				338	0	338	0	59	6	17	6				
				676	0	257	10	13	2	21	3				
				82	4	90	0	33	5	28	0				
				55	0	180	0	133	10	106	9				
				95	0	95	0	17	6	19	3				
				6	2	69	2	88	2						
				42	6	45	0	28	8						
				104	10	94	6	74	11						
				45	0	50	8	17	7						
				101	4	137	6	28	0						
				112	4	31	3	28	0						
				271	3	238	4	28	0						
				125	0			108	0						

These columns are to be added up, subtracting the deductions from the additions, and the remainder is to be reduced to the standard thickness of 1½ brick, and brought into rods of 272 ft. 3 in. superficial.

SQUARES.		YARDS.				FEET.			Nos.
Tiling.		Paving.							
Plain.	Pan.	Grey Stock.	Dutch Clinkers.	Brick-nogging.		Super.		Runs.	
		Common Bricks.	10 inch Tiles.						
			12 inch Tiles.						

If different sorts of bricks are used, separate heads must be formed in the Abstract, each detailing the various proportions and descriptions of the work.

ROTATION.

To be attended to in bringing the quantities into Bill.

BRICKLAYER.

Yds. ft. in.		
	Cube of concrete to foundations, composed as specified . .	
	Supl. do. to floors, &c., less than 12 in. thick . . . . *(State thickness.)*	
Rods ft. in.		
	Supl. reduced brickwork, if stock bricks, if part with other bricks, their proportions, &c. .	
	Do. do. to garden walls . . *Or whatever way the work may be done at per rod.*	
Sqrs. ft. in.		
	Supl. pan-tiling, if dry or pointed inside or out	
	Do. plain-tiling, if double fir laths and wrought nails, &c. . . *Or other articles by the square.*	
Yds. ft. in.		
	Supl. brick-nogging, flat or on edge	
	Do. brick paving, do. . .	
	Do. 10 in. or 12 in. tile paving .	
	Do. pebble paving . . .	
	Do. tuck pointing . . . *Or other articles by the yard superficial.*	
Ft. in.		
	Supl. gauged arches . . .	
	Do. malm facings, either as best or seconds	
	Do. extra only, in cement . .	
	Do. do. to arches in cement .	
	Do. half-brick trimmers . .	
	Do. cutting splays, &c. . .	
	Do. asphalting, or slates in cement to form damp-proof course .	

Ft. in.			
	Supl. extra and battering face of wall		
	And all other articles at per foot superficial.		
	Run of cutting to narrow splays, or birds'-mouths, &c. . . .		
	Do. do. and pinning into wall .		
	Do. pipe drains jointed in cement or clay		
	And all other articles at per foot run.		
Nos.			
	Terra-cotta chimney moulds, and setting in cement . . .		
	Door and window-frames, bedded and pointed		
	Flues cored		
	Traps, junctions, bends, &c. to drains		
	And all other articles that are numbered.		
	Labour and materials to setting stoves, ranges, coppers, &c. .		

VALUATION OF BRICKLAYERS' WORK.

SIZE AND WEIGHT OF VARIOUS ARTICLES.

	Length.		Breadth.		Thickness.		Weight.	
	ft.	in.	ft.	in.	ft.	in.	lbs.	oz.
Stock bricks . . . each .	0	8¾	0	4¼	0	2½	5	0
Paving do. . . . do. .	0	9	0	4½	0	1¾	4	0
Dutch clinkers . . do. .	0	6¼	0	3	0	1¼	1	8
12-inch paving tiles . . do. .	0	11¾	0	11¾	0	1½	13	0
10-inch ditto . . do. .	0	9¾	0	9¾	0	1	8	9
Pan tiles. . . . do. .	1	1½	0	9½	0	0½	5	4
Plain tiles . . . do. .	0	10½	0	6¼	0	0⅝	2	5
Pantile laths, per 10 ft. bundle .	120	0	0	1½	0	1	4	6
Ditto, per 12 ft. bundle . . .	144	0	0	1½	0	1	5	0
A bundle contains 12 laths.								
Plain tile laths, per bundle . .	500	0	0	1	0	0¼	3	0
Thirty bundles of laths make a load.								

A bricklayer's hod measures 1 ft. 4 in. × 9 in. × 9 in., and contains 20 bricks.

A single load of sand is 27 cubic feet, or one cubic yard.

A double load of sand is 54 cubic feet, or two cubic yards.

A measure of lime is 27 cubic feet, or one cubic yard, and contains from 16 to 18 bushels.

QUANTITIES, ETC.

A rod of brickwork measures 16 ft. 6 in. × 16 ft. 6 in., or 272 ft. 3 in. superf., 1½ brick, or 13½ in. thick, called the standard thickness, or 306 cubic feet, or 11⅓ cubic yards.

A rod of brickwork laid to a 12-in. gauge, *i.e.* four courses to measure one foot in height, requires 4353 stock bricks.

Ditto, laid to 11½-in. gauge, requires 4533 stock bricks.

A foot superficial of reduced brickwork requires 16 bricks.

These calculations are made without allowance for waste; and indeed there is very little, as nearly every part is worked in, and much space is occupied by timbers, flues, &c., for which no deduction is made in measurement; and therefore in the erection of dwelling-houses containing flues and bond timbers, 4300 stocks is quite sufficient, and this is the usual number allowed for a rod of brickwork.

5370 stocks to the rod, if laid dry.

4900 do. in wells and circular cesspools.

A rod of brickwork, laid four courses to gauge 12 in., contains 235 ft. cube of bricks, and 71 ft. cube of mortar; and the average weight is about 15 tons.

A rod of brickwork requires 1½ cubic yard of chalk lime and three loads of sand; or one cubic yard of stone lime, and 3½ loads of sand; or 36 bushels of cement, and 36 bushels of sharp sand.

A cubic yard or load of mortar requires nine bushels of lime and one load of sand.

Facing requires 7 bricks per foot superficial.

Gauged arches 10 do. do.

Brick-nogging per yard superficial, requires 30 bricks on edge, or 45 laid flat.

PAVING.

Description.		Number required.
Stock bricks, laid flat	per yard	36
Do. on edge	do.	52
Paving bricks laid flat	do.	36
Do. on edge	do.	82
Dutch clinkers do.	do.	140
12-inch paving tiles	do.	9
10-inch do.	do.	13

TILING.

	Gauge	Number required
	Inches	
Pan tiles, per square	12	150
Do. do.	11	164
Do. do.	10	180
A square of pan-tiling requires one bundle of laths and 1¼ hundred of 6*d.* nails		
Plain tiles, per square	4	600
Do. do.	3½	700
Do. do.	3	800
Do. do.	laid flat	210
A square of plain-tiling requires one bundle of laths and nails, one peck of tile pins, and three hods of mortar.		

CALCULATION OF LABOUR.

The following table, although far from complete, contains constants for all the principal descriptions of bricklayers' work:—

	Constant.
	To be multiplied by the rate of wages for a labourer per day.
Concrete.—Labour in mixing, wheeling, throwing-in from a stage, and puddling (where required to be done), including erection of scaffolding, per yard cube	·335
	To be multiplied by the rate of wages for a bricklayer and labourer per day.
Brickwork, per rod	4·941
	To be multiplied by the rate of wages for a bricklayer per day.
Extra labour to malm facings	·014

			To be multiplied by the rate of wages for a bricklayer and labourer per day.
Paving.			
Brick paving laid flat in sand .	per yard	.	·046
Do. laid on edge in sand . .	do.	.	·075
Do. laid flat in mortar . . .	do.	.	·056
Do. laid on edge in mortar . .	do.	.	·084
Paving-brick paving laid flat in sand	do.	.	·046
Do. laid on edge in sand . .	do.	.	·106
Do. laid flat in mortar . . .	do.	.	·075
Do. on edge in mortar . . .	do.	.	·121
Clinker paving on edge in sand .	do.	.	·132
10 or 12 inch tile paving . .	do.	.	·010
Tiling.			
Pan-tiling laid dry . . .	per square	.	·422
Do. pointed outside . . .	do.	.	·685
Do. pointed inside and outside .	do.	.	·790
Plain-tiling laid to a 4-inch gauge .	do.	.	·739
Do. . . to a $3\frac{1}{2}$-inch gauge .	do.	.	·764
Do. . . to a 3-inch gauge .	do.	.	·790

It would be impossible to give examples for every case that might occur ; but the following will show the method of valuing the principal descriptions of bricklayers' work.

Ex. 1.—To find the value of a cubic yard of concrete, made in the proportion of six parts of gravel to one of lime.

		£ s. d.
1·1 yard of gravel, at per yard, prime cost .		
Carriage of above to the works		
Three bushels of lime, at per bushel . . .		
—— per cent. profit		
Labour on the above, found by multiplying the rate of wages per day for a labourer by the decimal ·335		
Value per cubic yard . . .	£	

Ex. 2.—To find the value of a rod of brickwork.

	£ s. d.
4300 stocks, at per thousand	
$1\frac{1}{2}$ yards of lime, at per yard	
Three loads of sand, at per load . . .	
—— per cent. profit	
Scaffolding	
Labour per rod, found by multiplying the rate of wages per day for a bricklayer and labourer by the decimal 4·941	
Value per rod	£

Ex. 3.—To find the value of a foot of malm facing.

	£ s. d.
No. 7 best malms (or seconds, as the case may be), at —— each	
DDt. the value of seven bricks, according to the quality with which the walls are built, the facing having been measured with the wall —— at —— each	
Extra value of the malm bricks	
Extra labour on the malm bricks, found by multiplying the rate of wages per day for a bricklayer by the decimal ·014	
	£

Ex. 4.—To find the value of a yard of paving,—say with stock bricks laid flat in sand.

	£ s. d.
36 stocks, at —— each	
Sand	
—— per cent. profit	
Labour, found by multiplying the rate of wages for a bricklayer and labourer by the decimal ·046 .	
Per yard	£

Ex. 5.—To find the value of a square of plain tiling, laid to a four-inch gauge.

	£ s. d.
600 plain tiles, at per thousand . . .	
One bundle of laths and nails	
One peck of tile pins	
Three hods of mortar	
—— per cent. profit	
Labour, found by multiplying the rate of wages for a bricklayer and labourer per day by the decimal ·739	
Per square . . . . . £	

TABLE,

Showing the value of reduced brickwork per rod, calculated at the several prices of 3*l.* 5*s.*, 3*l.* 10*s.*, 3*l.* 15*s.*, 4*l.*, 4*l.* 5*s.*, 4*l.* 10*s.* *per rod, for mortar, labour, and scaffolding; and of bricks from* 30*s.* *to* 60*s.* *per thousand; allowing* 4500 *bricks to a rod.*

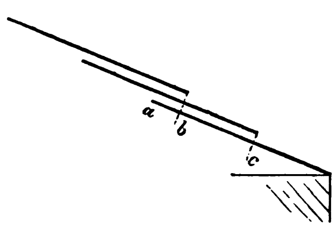
Bricks per M.	Mortar and Labour, per rod.					
	£3 5s.	£3 10s.	£3 15s.	£4	£4 5s.	£4 10s.
s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
30	10 0	10 5	10 10	10 15	11 0	11 5
32	10 9	10 14	10 19	11 4	11 9	11 14
34	10 18	11 3	11 8	11 13	11 18	12 3
36	11 7	11 12	11 17	12 2	12 7	12 12
38	11 16	12 1	12 6	12 11	12 16	13 1
40	12 5	12 10	12 15	13 0	13 5	13 10
42	12 14	12 19	13 4	13 9	13 14	13 19
44	13 3	13 8	13 15	13 18	14 3	14 8
46	13 12	13 17	14 2	14 7	14 12	14 17
48	14 1	14 6	14 11	14 16	15 1	15 6
50	14 10	14 15	15 0	15 5	15 10	15 15
52	14 19	15 4	15 9	15 14	15 19	16 4
54	15 8	15 13	15 18	16 3	16 8	16 13
56	15 17	16 2	16 7	16 12	16 17	17 2
58	16 6	16 11	16 16	17 1	17 6	17 11
60	16 15	17 0	17 5	17 10	17 15	18 0

SLATING.

SLATE is a natural material, which splits readily into thin slabs, and is largely used for building purposes, more especially as a covering to roofs, being lighter and more impervious to wet than tiles. There are various qualities of roofing-slates, those obtained from North Wales being most highly esteemed, on account of their great hardness and capability of being split into very thin plates. The weight of this slate is 180 lbs. per cubic foot. The Welsh slates are made into a great variety of sizes, but when used in roofing, one size only is used throughout the same roof; so that the *gauge* to which they are laid, or the distance from the bottom of one slate to the bottom of the next above or below, is the same all over the roof. They are usually laid with a *lap* of $2\frac{1}{2}$ in.; the bottom of the next course above the eaves course extending $1\frac{1}{4}$ in. below the middle line of the first or eaves course, and the bottom of the third course extending $1\frac{1}{4}$ in. below the middle of the second course, and consequently $2\frac{1}{2}$ in. (the *lap*) beyond the top of the first or eaves course; and so on all up to the top of the roof. The *gauge* is therefore the half length of the slate less half the lap.

Thus, in fig. 17 we have 3 courses of slates, in

FIG. 17.



which the distance from *a* to *b* represents the *lap*, and the distance from *b* to *c* represents the *gauge*.

Westmoreland slates are coarser and thicker than the Welsh, although their weight per cubic foot is less, being about 173 lbs. They are used of all sizes in the same roof, the largest being selected for the lower course, and gradually diminishing in size towards the top.

Slating is sometimes laid upon close boarding nailed to the rafters; but is more frequently laid upon fir battens or slate-laths nailed to the rafters at distances from centre to centre equal to the gauge to be given to the slates. Thus for countess slating with slates 20 in. long, in order to give a 2½ in. lap, the battens must be 8¾ in. from centre to centre. When battening is used for Westmoreland slates, the distance apart of the battens diminishes as they get nearer the top. As the battens are often put on by the slater, they may be included in the measurement and price of the slaters' work. Slates are fastened to the battens with copper or zinc nails, two to each slate, except in the very small sizes, which have one nail each. Holes are punched in the slates near the middle, for the nails to pass through. When slating is laid upon close boarding it is usual to put a layer of *asphalted felt* upon the boarding before laying the slates.

Slating is measured superficial, and charged per square of 100 ft. In measuring, allow for the eaves, whatever the bottom course measures, and for the hips and valleys measure their length by 12 in., namely, 6 in. on each side; also the length of all irregular angles, as chimneys, dormers, &c., by 6 in. wide, as a

fair allowance for cutting and waste. For circular slating allow one-third extra. Slate is also sawn into coverings for the hips and ridges, which are measured by the foot run, their thickness and width or girt being described. Slate steps are measured by the foot run. Slate slabs, shelves, &c. are measured by the foot superficial; so also are slate cisterns and tanks, including iron bolts.

In the following Table, the slating is all supposed to be laid with a 2½ in. lap.

VALUATION OF SLATERS' WORK.

TABLE OF MATERIALS AND LABOUR.

Sizes and Description of Slates.	No. of square ft. covered by 1 M. of 1200.	Wt. per M. of 1200 in cwt.		No. of slates to cover 1 square of 100 ft.	Wt. of copper nails to 1 sqr.	CONSTANT. To be multiplied by the rate of wages for a slater and labourer per day.	
		1st	2nd			Laying only.	Preparing and laying.
					lbs.		
Singles . 12″ × 6″	240	14	14	550	2¼	·180	·70
Doubles . 13″ × 7″	306	18	21	400	3½	·173	·66
Ladies, small 14 × 8	385	22	26	312	3	·160	·63
Do. large . 16 × 8	450	25	33	266	2½	·150	·60
Viscountess 18 × 9	580	31	40	210	2½	·145	·58
Countess . 20 × 10	730	40	54	164	2	·137	·55
Marchioness 22 × 11	900	48	60	133	2	·132	·53
Duchess . 24 × 12	1000	60	80	120	1¾	·120	·50
Princess . 24 × 14	1254	70	90	96	1½	·120	·50
	A ton will cover						
Imperials . 30″ × 24″; Rags and Queens 36 × 24	225 ft. to 250 ft.	...	...	...	...	...	·75
Westmrlnd., various	225	...	...	...	...	...	·80

Ex.—To find the value of a square of duchess slating, copper nailed.

	£ s. d.
No. 120 duchesses, at per thousand . . .	
1¾ lbs. copper nails, at per lb.	
—— per cent. profit	
Labour in preparing and laying, at per day .	
Value per square . . .	£

CHAPTER IV.

CARPENTRY AND JOINERY.

DEFINITIONS.

CARPENTRY is the framing together of timbers, as in forming roofs, floors, partitions, and all other work in which rough timber is employed.

JOINERY is the framing of wood together, for internal and external finishings of houses; thus the linings of walls, the coverings of timbers, laying of floor-boards, the construction of doors, windows, stairs, &c. are included in the joiner's work.

CARPENTRY.

The timbers used in forming the floor of a room are called the NAKED FLOORING. There are three different kinds of naked flooring; namely, single-joisted floors, double floors, and framed floors.

A SINGLE-JOISTED floor consists of one series of timbers called *joists*, which are laid across the room from wall to wall with their broadest side vertical; they are usually placed about 11 in. apart, and the floor boards are nailed on the top edge, the laths for the ceiling of the room below being nailed to their bottom edge. Their scantling, or sectional dimen-

sions, varies according to the span of the room, or length of bearing as it is termed, and the load which they are required to carry; and as their strength increases with the *square* of their depth, but only *as* the breadth, a doubling of their depth produces the same effect on the strength as quadrupling their breadth, but with half the quantity of timber. Hence the advantage of deep and narrow joists, to which there is no limit but in the tendency to lateral bending, for which transverse struts afford a remedy. These are usually placed in pairs crossing like an ⋈, and are then called *herring-bone strutting*; a row of which should be repeated every 5 or 6 ft. length of joist. The ends of joists are laid in the walls upon *wall-plates*, or pieces of timber built in with the brickwork and generally the thickness and breadth of one course of bricks; by means of the wall-plates the pressure of the joists is uniformly distributed over the whole length of the wall. When the joists are not all of exactly the same depth, the upper edges must be brought up to a perfect level by slips of wood laid under their ends upon the wall-plates; this is called *furring-up* the ends of the joists.

In forming the lowest floor of a building, it is usual to lay the joists upon *sleepers*, or timbers laid upon brick piers or *sleeper-walls* at frequent intervals; by which means the carpenter is enabled to use joists of smaller scantling and to save timber.

The following is about the usual scantling for fir joists according to their bearings:—For 5 ft. bearing, $4\frac{1}{2}$ in. × 2 in.; for 10 ft. bearing, 7 in. × $2\frac{1}{4}$ in.; for

15 ft. bearing, 10 in. × $2\frac{1}{2}$ in.; for 20 ft. bearing, 11 in. × 3 in. Where the floors have to carry extraordinary loads, the above scantlings must be increased in proportion.

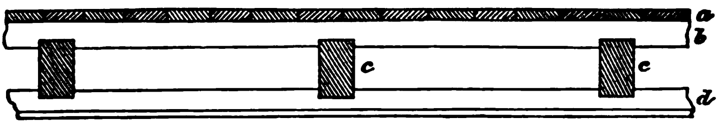
On account of flues, fire-places, openings for staircases, &c. it often happens that some of the joists cannot have a bearing on the wall. In such cases a piece of timber, called a *trimmer*, is framed between two of the nearest joists that have a bearing on the wall; and into this trimmer the ends of the joists requiring support are mortised. This mode of framing joists is therefore called *trimming*. Trimmers should always be of the same depth as the joists, but 1 inch thicker. The joists into which the trimmers are framed are called *trimming-joists*; these run in the same direction as the other joists, but must be stouter because they are weakened by having to receive the ends of the trimmers which are tenoned into them.

When one piece of timber is framed into another piece, the part cut out of the latter is called a *mortice*, and the part of the former which goes into the mortice is called a *tenon*.

A Double Floor is formed of three tiers of joists; namely, binding-joists, bridging-joists, and ceiling-joists; the *binding-joists* or *binders* have their ends resting on the wall and support the *bridging-joists* which are notched upon the top of them, and on these last the floor boards are laid. The *ceiling-joists* are merely timbers of small scantling spiked to the underside of the binders to receive the ceiling-laths of the

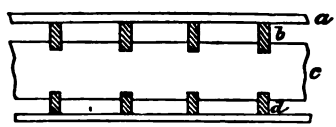
room below. A section of such a floor is shown in fig. 18, in which *a* is the flooring, *b* the bridging-

FIG. 18.



joists, *c* the binders, *d* the ceiling-joists. Fig. 19 shows a transverse section of the same floor.

FIG. 19.

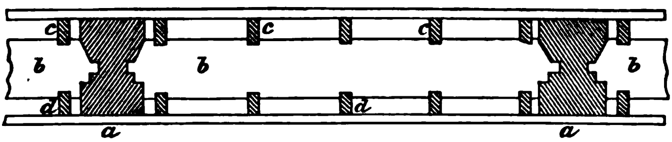


The scantling of the bridging-joists depends on the distance apart of the binders, and will be found as in single-joisted floors. The scantling of the binders must also depend upon their distance apart, and the load they have to carry; but for common floors, where their distance apart is 6 ft., their scantling, when of fir, may be as follows :—When the bearing is 10 ft., the scantling may be × 8 in. 8 in., or 10 in. × 4 in.; when it is 15 ft., the scantling may be 10 in. × 9 in., or 13 in. × 4 in.; when it is 20 ft., the scantling should be 14 in. × 6 in. The ceiling-joists should be at least 3 in. × 2 in. when the binders are 6 feet apart.

FRAMED FLOORS have the binders framed into large baulks of timber called *girders*, which last rest upon the walls or upon piers. In fig. 20 is shown a section of a floor of this description, *a*, *a* being the girders, *b*

the binders, *c* the bridging or floor joists, *d* the ceiling-joists.

Fig. 20.



The scantling of fir girders 10 ft. apart for ordinary floors, should be as follows. When the bearing is 15 ft., the scantling should be 12 in. × 9 in.; when it is 20 ft., the scantling should be 14 in. × 11 in., or 15 in. × 9 in. When it is 25 ft., the scantling should be 15 in. × 14 in., or 16 in. × 11 in.; when it is 30 ft. the scantling should be 16 in. × 16 in., or 18 in. × 12 in. When baulks of large scantling are used for the girders, they should be always sawn down the middle lengthwise, reversed, and the two parts bolted together; since timbers when used in large baulks are liable to twist.

Lintels are pieces of timber laid across the openings in walls to carry the weight of the superstructure; their thickness or depth must depend upon the bearing or span of the opening and the weight above, but for ordinary windows and doors they are usually from 4 to 6 in. deep, and rest 9 in. at each end on the wall.

Breast-summers, or Bressummers, are lintels placed over wide openings in walls, as for shop-windows, cart-ways, or openings for bay-windows; they are generally sawn down, reversed, and bolted together; and a truss of iron is sometimes introduced

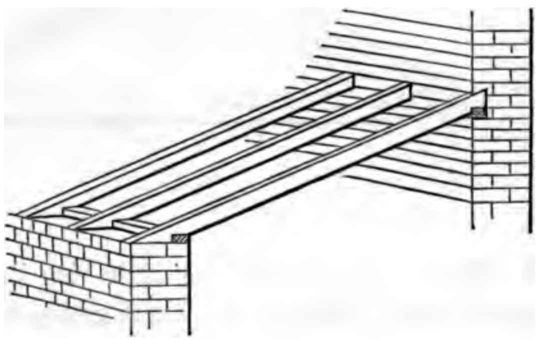
between the two halves or *flitches*. A plate of wrought iron, the exact depth of the beam, is sometimes introduced in the middle between the two flitches, and the beam is then termed a *flitch-girder*; the thickness of the iron plate should be about one-twentieth of the thickness of the wood. If we multiply the breadth of the beam in inches by the square of the depth, and divide the product by the span or bearing in inches, the result multiplied by 2300 will give the number of lbs. avoirdupois that may with perfect safety be distributed uniformly over the *whole length* of the girder, fir being the timber supposed to be used.

Quartered Partition is frame-work cf timber for dividing the internal parts of a house into rooms, where there is no cross wall on the lowest story to carry a brick partition. This kind of partition should never be allowed to rest with the whole weight upon the floor-joists, but should be trussed in such a manner as to throw the weight as much as possible on the walls at the two ends. Quartered partitions are formed of longitudinal timbers at top and bottom, called *head* and *sill*, into which are framed *braces*, or timbers placed diagonally across the partition; they are filled in with upright pieces about 11 in. apart, called *quarters*, to which the plaster-laths are nailed.

Roofs in carpentry, are the timbers framed together for the purpose of receiving the slates, tiles, lead, or other material by which the top of the building is to be covered in. The simplest kind of roof is that

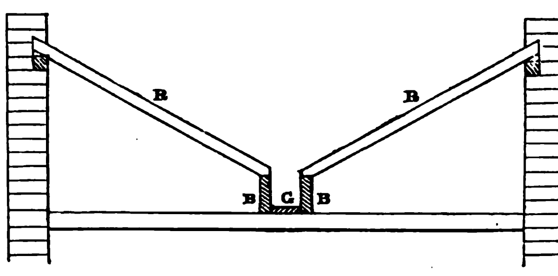
called a *lean-to* or *shed-roof*, in which a number of timbers called *rafters* rest upon wall plates laid on two walls, one of which is higher than the other, as shown in figure 21, and consequently the rafters have a slope or *fall* towards the lower wall.

FIG. 21.



A very common form of roof in town houses is the *V-roof*, or double lean-to, as shown in fig. 22.

FIG. 22.

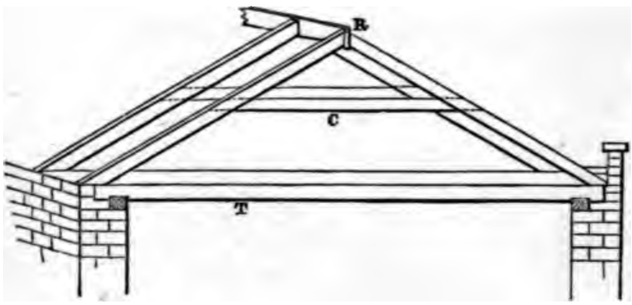


In this roof the rafters (R) rest at their feet upon two bearers (B) carried from back to front of the house, and forming a trough-gutter (G) along the middle. The upper ends of the rafters are supported by the party-walls.

When the walls are both of one height the rafters

are generally put together in pairs, sloping upwards from each wall to a *ridge-piece* (marked R) in the centre, as shown in fig. 23.

FIG. 23.



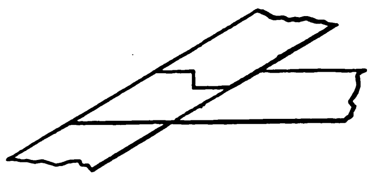
A *Hip Roof* is one whose ends rise immediately from the wall, having the same inclination to the horizon as the sides have; a hipped roof is of a pyramidal form, and the angles made by the meeting of the planes which form the pyramid are called the *hips*. *Jack-rafters* are the short rafters rising from the walls and framing into the hip-rafters. The length of the hip-rafter is found by dropping a plumb line from its vertex to meet a horizontal line from its foot, then adding together the squares of the lengths of those two lines, and taking the square-root of their sum.

A *Valley* is the opposite of a hip, being the internal angle formed by the two planes of a roof. *Valley-boards* are boards laid on each side of the angle to receive the lead.

In order to prevent the rafters of a roof from thrusting out at the feet, a horizontal piece of timber called a *collar* (marked C, fig. 23) is nailed across each

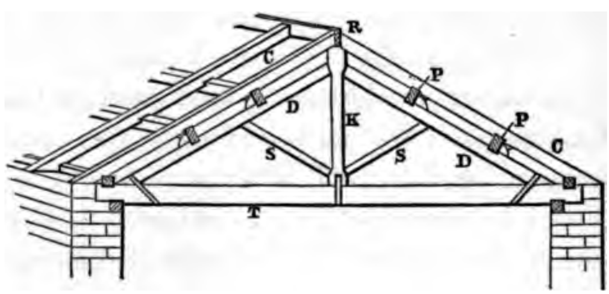
pair of rafters, at any convenient height, and *halved* on to them, as shown on fig. 24: when this piece is placed

FIG. 24.



at the *feet* of the rafters it is called a *tie-beam* (marked T), and in that case the roof has no outward thrust on the wall. When the span of the roof is considerable, the tie-beam will have a tendency to bend in the middle; to obviate which a piece of timber called a *king-post* (marked K, fig. 25) is introduced between

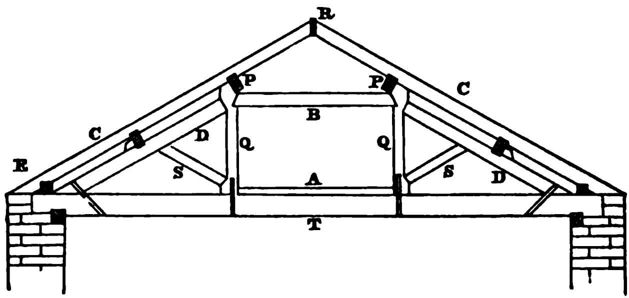
FIG. 25.



the heads of the rafters and the centre of the tie-beam; into the head of this post the rafters are framed and thus hold up the post, *shoulders* being formed in it for that purpose, the king-post holding up the centre of the tie-beam by means of a strap which is passed under it. Such a combination of timbers is called a *truss* or *principal.* When two upright pieces (fig. 26) are introduced to hold up the tie-beam, they are called *queen-posts* (marked Q), and the

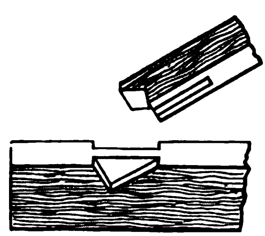
horizontal piece between their heads is called the *straining-beam* (marked B).

FIG. 26.



In order to stiffen the main rafters, pieces of wood called *struts* (marked S) are framed into the feet of the king or queen posts and also into the centre of the rafters. In the king-post roof the opposite thrusts of the struts counterbalance each other on the foot of the king-post; but in the queen-post roof their thrusts have to be conveyed along a straining piece (A) placed between the feet of the queen-posts upon the top of the tie-beam. The mode of framing the feet of the rafters into the tie-beam is shown in fig. 27.

FIG. 27.



When a roof is framed in either of the foregoing methods, the trusses do not themselves directly carry

the slates or other covering, but are placed about 10 ft. apart, and receive longitudinal beams called *purlins* or *side-wavers* (marked P), laid upon the *principal rafters* (D) of each truss, about 5 ft. apart; upon these purlins are laid the *common rafters* (marked C) about 11 in. apart, on which the covering of slates, &c. is laid. The feet of the common rafters rest upon a piece of timber laid upon the wall or upon the ends of the tie-beam, which is called the *pole-plate* (marked E).

When the covering for the roof is to be lead, the rafters must be laid over with close-boarding, on which the lead is secured by means of rolls of wood placed every 2 ft. or 3 ft. apart and fixed from bottom to top, and over which the lead is dressed. If slate or tile is the material of the covering, battens or laths are nailed horizontally along the rafters at distances apart regulated by the gauge of the slates or tiles (see SLATING and TILING): at the eaves of a slated roof an *eaves-board* is generally laid, to give solidity to the slating at that part; and in order to check the rush of water into the gutter at the eaves, the slates are tilted up there by means of a strip of wood called a *tilting-fillet*; similar fillets are also laid along the edges of valleys, and wherever the slating abuts against a wall.

When the ridge or hips are to be covered with lead or zinc, a rounded roll of wood is spiked to the whole length of hip-rafter or ridge piece, and is called a *ridge-roll*. When there is a parapet wall at the eaves of the roof, a gutter has to be formed by means

of horizon pieces called *bearers*, spiked to the feet of the rafters, and on which the *gutter-boards* are laid to receive the lead (fig. c, Plate 3).

Ashlering is the name given to upright quarters fixed between the joists and rafters of an attic or room in the roof, to cut off the acute angles formed by the feet of the rafters with the joists.

A Curb-roof, or Mansarde, is one in which the rafters on each side are in two separate lengths, and form an external angle (A) at their junction, as in fig. 28. A collar-beam (c) is introduced at the junction of the two sets of rafters.

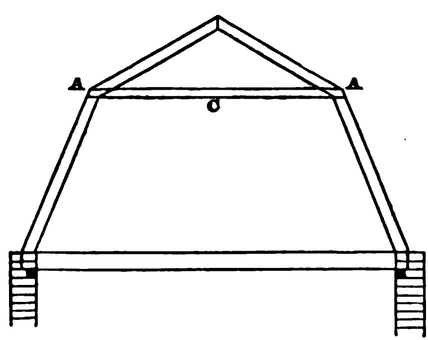


Fig. 28.

The *pitch* of a roof is the angle which the feet of the rafters make with the tie-beam; and the pitch is said to be *high* or *low*, according as this angle is large or small. When the covering of the roof is lead or zinc, the pitch may be as low as 4°, or just sufficient to allow the water to run off; for slating and tiling, it should never be less than 25° to 30°.

Roofs may have the feet of their rafters prevented

from thrusting outwards without employing a *horizontal* tie-beam, as shown in figs. 29, 30, 31.

Fig. 29.

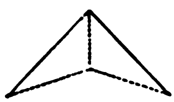


Fig. 30.

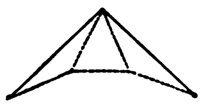
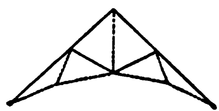
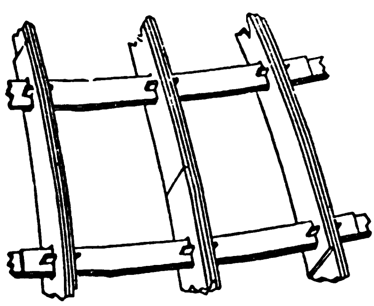


Fig. 31.



Domical or Cylindrical roofs may be constructed of timber, on the principle suggested by Philibert de Lorme, as shown in fig. 32. In this

Fig. 32.

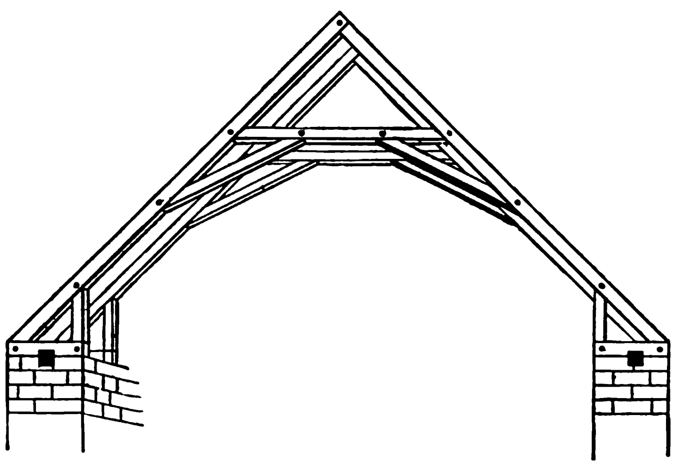


method a series of curved ribs are placed so that their lower ends stand upon a curb at the base, and the upper ends meet at the top, diagonal struts being introduced between them. These ribs are formed of planks put together in thicknesses, with the joints crossed and well bolted together; there should be at least three thicknesses in each rib, not bent, but applied flat together in a vertical plane, and their edges cut to the proper curvature; the layers of the ribs may be held together without bolts, by merely the horizontal rings or purlins, which pass through a

mortice hole in the middle and have themselves a slit into which a wooden key is driven on each side of the rib, as shown in the figure.

Collar-roofs are frequently used over Gothic buildings of moderate span, as shown in fig. 33.

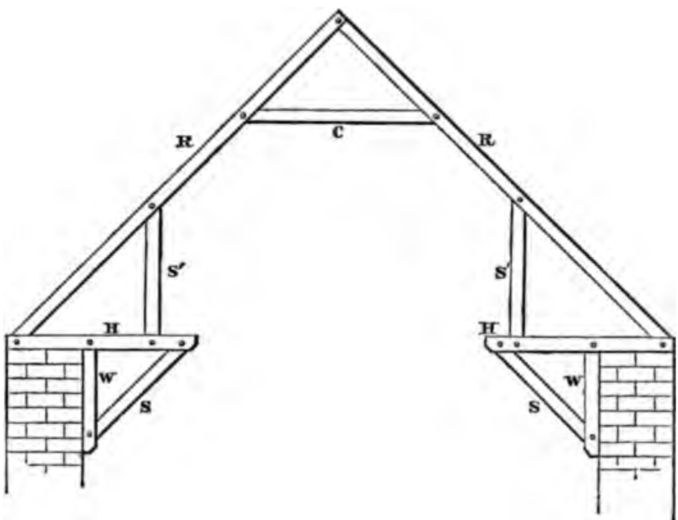
Fig. 33.



In this form of roof the *collar* is placed high up, tenoned into the rafters, and secured thereto with oak pins. Diagonal pieces, called *braces*, are also tenoned into both the collar and the rafters, and secured with pins. The foot of each rafter is framed into a horizontal *wall-piece*, which is notched upon the wall-plate and lies across the whole thickness of the wall; into the inner end of this wall-piece a vertical strut is framed, and also into the rafter itself. By this arrangement the outward thrust on the wall is greatly counteracted, and the weight thrown nearly vertically upon it.

Hammer-beam roofs are sometimes found over old Gothic buildings, and their form is shown in fig. 34.

Fig. 34.



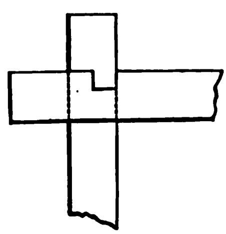
In this kind of roof we may suppose that the feet of the rafters are first prevented from spreading by being framed into a tie-beam; the middle part of the tie-beam is afterwards cut away, and the remaining parts (marked H) are called *hammer-beams*. To prevent these beams from thrusting outwards, a diagonal strut (marked S) is framed into its inner end, and also into a vertical wall-piece (W), which is itself framed into the underside of the hammer-beam. A vertical strut (marked S′) is also placed between the rafter and the end of the hammer-beam. By this means a considerable amount of the thrust of the rafters is thrown vertically down the walls. There will, how-

ever, always remain sufficient horizontal thrust to push out the walls, if they are not built very strong, or supported by external buttresses.

BARGE-BOARDS are boards of an ornamental character, used on gables where the covering of the roof extends beyond the face of the wall. The *barge* projects from the wall a few inches and either covers the rafters or occupies their place. The slating or tiling projects over the face of the board.

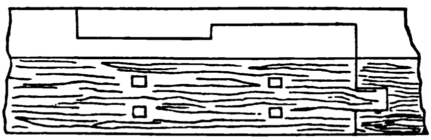
When a wall-plate is carried along two adjoining sides of a wall, as in the case of a hipped-roof, it is usual to *halve* the two ends upon each other, so as to prevent them from separating at the angle, as shown on fig. 35.

FIG. 35.



It frequently happens that a long straight piece of timber is required, as in the tie-beam of a roof of large span; it is then usual to make the beam in two lengths, which are joined in the middle. The simplest method of joining beams longitudinally is by means of a *fished-joint*, the two ends being made to abut against each other, and a plate of iron bolted on each side, so as to cover the joint and prevent it from opening. Another mode is called *scarfing*, as shown on fig. 36, in which each piece is toothed out to receive

the other, and the two are fastened together by keyed wedges driven through the timber.

FIG. 36. 

CENTERING is a framework of timber temporarily erected to support the arch-stones or *voussoirs* of an arch during its construction, and until the mortar in which the stones are bedded has become sufficiently set to allow the arch to stand without any intermediate support. Centerings are composed of several separate vertical trusses connected by horizontal ties, and stiffened by braces, the nature of such trusses depending upon the span of the arch. In small arches formed over openings in the wall of a house, a centering is made by forming two *turning-pieces* cut to the shape of the arch, to which boards are nailed for the voussoirs to rest upon. In large arches great care has to be taken in the construction of the framing for the centering, in order that it may not lose its shape by the pressure of the voussoirs, the laying of which must always be proceeded with uniformly on the two sides of the arch. In designing the centering of a large arch it must be borne in mind, that the voussoirs near the crown press with greater force upon the framework than those near the springing; hence it is necessary that the centering be made stronger and stiffer in the upper parts than in the lower. On account of the adhesion of

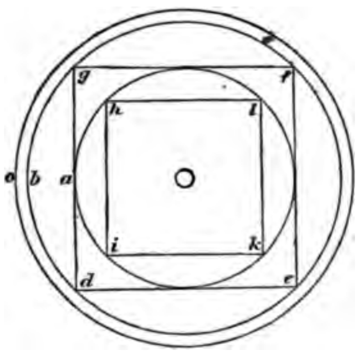
the mortar to the bricks or stones forming the arch, there is little or no pressure on the centering until the joints make an angle of 30° with the horizon; and when they make an angle of 45° with the horizon the pressure amounts to only one-fourth of their actual weights; at an angle of 60° their pressure on the centering is over one-half their actual weights; but it may be taken as a general rule, that any voussoir in which a plumbline from the centre of gravity falls outside its lower joint, presses with its full weight upon the centering until the whole arch is completed or keyed-up.

Park and garden FENCES are formed with oak posts let into the ground 9 ft. apart, to which are framed horizontal bars called *arris-rails*, against which the *feather-edged* (thicker on one edge than the other) oak palings are nailed. A 1½ inch oak plank 12 in. wide is fixed at the bottom. Fences are measured by the rod run of 16 ft. 6 in. or 5½ yards, and valued according to the height of the palings. If oak capping is placed on the top, it is measured extra; the plank at bottom is also measured extra.

TIMBER used in carpentry being cut out of trees which have grown by annual deposits of new layers of wood on the outside, it follows that the different layers of which it is composed possess different qualities of hardness and strength; the old or inner layers being the hardest, and the outer or new layers being the softest. If we suppose fig. 37 to represent the section, taken transversely, of a timber tree, the inner circle *a* will be the boundary of the *wood* proper;

the next circle *b* that of the last deposit, and the space between these two circles is called the *sap-wood*; the outer circle *c* represents the *bark*, which is stripped off before the tree is cut up into timber.

FIG. 37.



If, then, a *baulk* of timber is cut out of the tree as shown by the square *d e f g*, the four corners will consist of sap-wood, and will be useless for purposes of construction. To obtain a baulk entirely free from sap-wood, it is necessary to cut the tree as shown by the square *h i k l*. The sap-wood possesses very little strength, and is also very liable to decay; its presence in timber can easily be detected by its totally different appearance to the inner wood. In old trees the part in the centre (O) called the *pith* is the first of the inner wood that decays, and the *dead-knots* found in wood are the dried-up or partly decayed pith of the branches. Baulks of timber are also frequently found, when cut down the middle, to be rotten in the centre; hence it is never advisable to use them in their natural size and shape; but when employed as girders or bressummers, they

should be sawn down, reversed, and bolted together, by which means any tendency to twist is prevented, as well as any internal decay detected.

The weight which a beam, when supported at each end, will bear in the centre is found by multiplying its breadth by the square of its depth, and dividing the product by the length of the bearing, all the dimensions being in inches; the quotient is then to be multiplied by 4300 for Riga fir, and by 6600 for English oak, and the result is the *breaking-weight* in lbs. avoirdupois. If the weight is uniformly distributed over the entire length of the beam, the *breaking-weight* will be twice as great as when it is all concentrated at the centre. The *permanent-load* which a beam of wood is made to bear, should not be greater than one-sixth of the breaking-weight. If a beam whose transverse section is a parallelogram of unequal sides is laid with its broader side horizontal, it will bear much less load than if laid with its broader side vertical, the strength being proportional to the *square* of the depth, but simply *as* the breadth. Thus, if one side of the section is double the other side, the strength of the beam, when laid with the broader side vertical, is double what it is when laid with the same side horizontal.

Timber when used as struts, pillars, or shores, has to sustain a load acting in the direction of its length, which tends partly to crush the fibres and partly to bend them. When the length of a pillar is more than twenty-five times the breadth or diameter, the resistance to crushing does not come in play, but the

timber yields by bending only. In this case, the *breaking-weight* in lbs. avoirdupois is found by dividing the *fourth* power (or square of the square) of the diameter in inches by the square of the length in feet, and multiplying the quotient by 24,542 for oak, and by 17,511 for red deal. The *permanent* load ought not to exceed one-tenth of the breaking-weight, so that it may be found at once by using 2454 and 1751 respectively as the multipliers. In this case the weight is supposed to act directly down the axis of the pillar; but if it acts otherwise, as down the diagonal, the resisting power will be reduced to one-third of the above.

When the length of pillars or struts is less than twenty-five times and more than ten times their diameter, they yield partly by crushing and partly by bending. To obtain approximately their strength, first find the breaking-weight, as above described for long pillars, and multiply that quantity by the area of the section of the pillar in inches, and then by 6000 for fir, and by 10,000 for oak; then take three-fourths of the area of section multiplied by either of the above numbers (according to the material), and add it to the breaking-weight first found; divide the first found breaking-weight by the last-named sum, and the quotient is the true breaking-weight in lbs. avoirdupois.

For pillars whose length is less than ten times the diameter, the resistance to crushing need only be considered, and it is found by multiplying the area of section in square inches by one or other of the

above-mentioned numbers according to the material used.

The following rule will enable us to find with sufficient accuracy the breaking-weight of a square pillar of oak, in which the length is more than 5 times the diameter or side of the square: take the *ratio of length to diameter*, square it, and add it to 350; then divide 34,000 by the sum, and the result is the breaking-weight in cwts. per *square inch of section*; this multiplied by the number of square inches in the cross section gives the strength of any particular pillar. If the pillar has a circular section, first multiply the ratio of length to diameter by $\frac{8}{7}$ before applying the rule. The safe permanent load may be taken as $\frac{1}{10}$th of the breaking-weight, as found by this rule. The ends of the pillars are supposed perfectly flat and parallel, and the load pressing directly down the axis of the pillars.

These rules for calculation of the strength of timbers can only be considered as approximations, as much will depend on the *part* of the tree from which the beam is cut; the wood cut from the inner part being stronger than that cut from the outer part. The strength of timber also varies very much according to the amount of water it contains; that of very wet timber being only half as great as of that which has been well dried.

When timber is used in tie-beams, braces, or collars, it has to resist a *stretching-force*, which is directly proportional to the area of its transverse section. The force (in lbs. avoirdupois) that will tear asunder

the fibres of a piece of timber by stretching in the direction of its length is found by multiplying the sectional area in square inches by 12,000 for fir, and 15,000 for oak.

The several timbers which compose a FRAMED TRUSS are subjected to every variety of strain that has been above mentioned. The rafters have to bear a compressing-force in the direction of their length, and also a transverse strain perpendicular to their length. The tie-beam is subjected to a stretching-force acting in the direction of its length, and also to a transverse strain arising from its own weight and that of the ceiling attached to it. The collars are strained by a stretching-force in the direction of their length, and also transversely by the action of their own weight, which may be considered as a load uniformly distributed over their whole length. The king and queen posts are strained by a stretching-force only acting in the direction of their length; the struts by a compressing-force acting down their length, and also by their own weight acting transversely when they are not placed vertical. Braces are always subjected to a stretching-force acting longitudinally, and also to a transverse strain from their own weight, increasing in magnitude as they are more and more inclined from a vertical position. Straining-beams are subjected to a longitudinal compressing-force, and also to the transverse strain from their own weight. Purlins are only strained by a transverse force arising from their own weight and the load of the roof covering which is laid upon them. Hammer-beams

are subjected to a longitudinal extending force. The strains on the timbers of floors, lintels, and bres-summers, may be considered as entirely transverse or perpendicular to their length. The action, however, of all transverse strains is to stretch the fibres on one side of the beam, and to compress them on the opposite side.

The scantlings of the several timbers of a *king-post* roof vary according to the span or bearing. For a span of 20 ft., the tie-beam should be 9 in. by 5 in.; for 24 ft., 11 in. × 5 in.; for 30 ft., 12 in. by 6 in. The scantling of the king-post for the above spans should be—4 in. by 3 in.; 5 in. by 4 in.; 6 in. by 5 in. The principal rafters—4 in. by 4 in.; 5 in. by 4 in.; 6 in. by 4 in. The struts—4 in. by 2 in.; 4 in. by 3 in.; 5 in. by 3 in. The purlins, when the trusses are 10 ft. apart—8 in. by 5 in.; 9 in. by 5 in.; 9 in. by 9 in. Common rafters, 4 in. by 2 in.

In a queen-post roof of 36 ft. span, the tie-beam should be 10 in. by 5 in.; of 40 ft. span, 11 in. by 6 in.; of 44 ft. span, 12 in. by 6 in. The queen-posts for the above spans should be—5 in. by 4 in.; 6 in. by 4 in.; 6 in. by 5 in. The principal rafters—6 in. by 5 in.; 6 in. by 6 in.; 7 in. by 6 in.; the straining-beam—7 in. by 5 in.; 8 in. by 6 in.; 9 in. by 6 in. The struts, 4 in. × 3 in. The purlins, where the trusses or principals are 10 ft. apart, 9 in. by 5 in. The common rafters, 4 in. by 2 in.

The pitch of the roof is supposed here to be about 30°, the covering slate, and the timber the best Memel or Riga fir. If a heavier material, as tiling

or lead, is employed as a covering, greater strength must be given to the timbers.

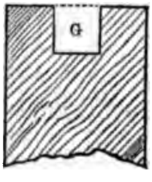
The tie-beams whose dimensions are given above are supposed to have to carry the weight of a ceiling in addition to their own weight. Where there is no ceiling, a light iron tie-rod may be substituted, with economy, for the heavy tie-beam.

JOINERY.

JOINERS'-WORK requires greater accuracy of workmanship than carpenters'-work, being nearer to the eye and subject to closer inspection; the joints must therefore be accurately fitted, and the exposed surfaces rendered perfectly smooth. The wood used in joinery, called *stuff*, consists of *planks* or *boards*, *deals*, and *battens*, according to their widths; their thickness as imported being 2½ in. or 3 in. *Battens* vary in width from 2 in. to 7 in.; *deals* are generally 9 in. wide; *planks* are 11 in. wide.

GROOVING, or PLOUGHING, is the forming a channel or *groove* of uniform width in a piece of wood as in fig. 38, marked G.

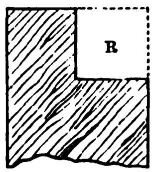
FIG. 38.



REBATING is the cutting a rectangular strip or

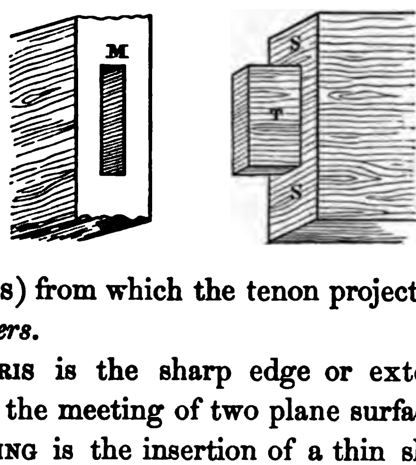
rebate out of one side of a piece of wood, as in fig. 39, marked R.

FIG. 39.



MORTISING is the cutting a rectangular cavity or *mortise* within the surface of a piece of wood, in order to receive a corresponding rectangular piece, called a *tenon*, projecting from another piece of wood, as in fig. 40, M being the mortise, and T the tenon;

FIG. 40.

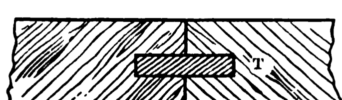


the parts (S) from which the tenon projects are called the *shoulders*.

An ARRIS is the sharp edge or external angle formed by the meeting of two plane surfaces.

TONGUEING is the insertion of a thin slip of wood or iron, called a *tongue*, into grooves cut or *ploughed* in two pieces of wood, for the purpose of keeping their faces in one continuous plane, as in fig. 41,

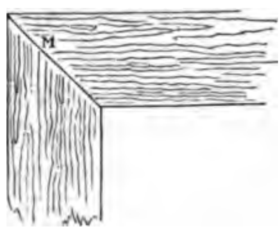
FIG. 41.



T being the tongue; when the tongue is cut across the grain of the wood, it is called a *feather-tongue.*

A MITRE is the diagonal joint which two pieces of wood make with each other when meeting at an angle, as M in fig. 42. A *mitred border* is put round

FIG. 42.

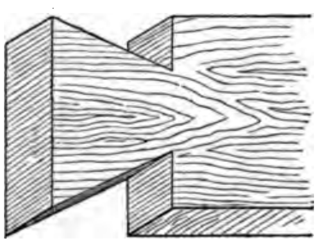


the hearths of fireplaces, to separate them from the wood floor.

SHOOTING is the term applied to the making a straight edge to a board, which is then said to be *shot.*

DOVETAILING is the joining two boards by indenting them together, the sections of the projection and hollows being in the form of a dovetail, as shown in fig. 43.

FIG. 43.



CLAMPING is when several boards are fastened together to form one plane surface, by means of another board, or *clamp*, fixed transversely at each end by means of mortise and tenon, or by a groove and tongue. If the clamp forms a mitre at each end with the two outer boards, it is then said to be *mitre-clamped.*

BLOCKINGS are small pieces of wood fitted and glued to the interior angle of two boards, in order to strengthen the joint, as in the junction between the treads and risers of stairs.

HOUSING is the cutting a piece out of one board for the insertion of the end of another, in order to fasten the two together.

STAIRCASES are flights of steps for passing from one floor to another, and are formed with *treads* and *risers*, the riser being mortised into the tread which overhangs it with a *nosing*, which is generally rounded or moulded. The ends of the treads and risers are supported on *string-boards*, one placed against the wall and called the *wall-string*, and the other at the outer ends called the *outer-string*. The treads and risers are housed into the wall-string, and also into the outer-string which is then called a *close string*; or the outer string-board is cut away to receive them, in which case it is mitred to the treads and risers, and the nosings of the steps are continued round their outer ends. When the stairs are formed in two flights, with a landing or resting-place between, the term *quarter-space* or *half-space* is applied to the resting-place, according as a quadrant or semi-circle is described in passing from one flight to the other.

The stairs which turn round a solid *newel-post*, or a circular *well-hole*, are called *winders*, the treads being wider at the inner end next the wall than at the outer end. The *newel-post* is an upright piece of wood into which the string-boards are framed. The

term *dog-legged* stairs is applied to those which have no well-hole, the steps being fixed to newels and string-boards. The *carriages* are pieces of timber placed underneath the steps and following the pitch of the staircase, to give firmness to the flight. The *handrail* is a bar or rail raised upon slender posts called *ballusters*, to protect the outer edge of the staircase and to assist persons in ascending and descending. When the handrail is made continuous round a well-hole staircase the part where it turns round the well is called the *writhe* or *wreath*. A *ramp* is where the handrail makes a sudden rise without turning round, as in framing into a newel-post. Handrails are jointed together in lengths and fastened with *handrail screws*. A *curtail-step* is the first step by which a staircase is ascended, finished at the end in the form of a scroll. The *apron-piece*, or *pitching-piece*, is a horizontal timber let into the walls on each side of the landing or half-space of a staircase to which the carriages are fastened. The *apron-lining* is the thin deal facing which covers the apron-piece.

SKIRTING is a narrow board or margin placed against the wall of a room next the floor, and is either moulded or plain. It is fastened to a narrow slip of wood called the *skirting-ground*, which is nailed to plugs let into the wall.

LININGS *of a door* are the internal facings which surround the *jambs* or sides, and the *soffit* or top, of a door opening; they are *rebated* to receive the door; when rebated on both edges for the sake of uniformity, they are said to be *double-rebated*.

GROUNDS are pieces of wood which are placed round openings, and wherever the plaster of a room is to stop abruptly, for the plaster to finish against, and are made the exact thickness of the plaster ; they are nailed to plugs let into the wall.

ARCHITRAVES are the mouldings which are planted round door, window and other openings.

BOXINGS are the cases into which shutters are folded when hung in more than two widths. *Back-flaps* are the parts of the shutters which fold into the boxings. *Window-back* is the framed lining below the window, between the window-sill and the floor; *elbows* are the corresponding linings under the boxings of the shutters.

ANGLE-STAFFS are slips of wood fastened to plugs at the corners of chimney-breasts for the purpose of protecting the plaster, which would be broken off if brought to a sharp arris. Angle-staffs are either square or beaded: if the walls are intended to be papered, square staffs are used; but if they are to be painted, beaded staffs are fixed, and the plaster is *quirked* against them.

MATCHED-BOARDING is when a number of boards of equal width, having a bead and tongue worked on one edge and a groove on the other edge, are fitted together to form one surface.

A SASH is the part of a window intended to receive the glass, and is made to open and shut. *Hung-sashes* are formed in two parts or *sheets*, called the *top* and the *bottom* sash ; these work in two grooves in the sash-frame or *case*, and are hung by cords passing

over pullies and attached to balance-weights concealed at the back of the case; the grooves in which the sashes work are called *pulley-pieces*, and are separated by a *parting-slip*, which keeps the two sashes apart, and enables them to pass each other without touching. The bottom of the sash-frame, called the *sill*, which is generally of oak, is sunk, and *weathered* outwards to carry off the rain. The *sashes* consist of upright pieces or *stiles*, top, bottom, and meeting *rails*, and sash-bars. These are rebated on the outside to receive the glass, and moulded on the inside in various forms, the most common of which are the plain chamfer bar, the ovolo, the lamb's-tongue, and the astragal and hollow. The sashes and frames are always taken in one measurement, the thickness of the sash and character of moulding being described, and also the quality of axle-pullies, whether iron or brass, and the kind of cord used for hanging. When only one sheet of the sash is made to open, it is said to be *single-hung*; when both sheets open, the sashes are *double-hung*.

Casements are sashes which are hung to a solid rabbeted frame by means of hinges; they are also called *French windows* when hung *double*, or in two parts folding together.

Dormer is a window made upon the slope of a roof, the frame being set up perpendicularly; the sides next the slating are termed the *cheeks*.

Skylight is a window placed over an opening made in a roof, and generally follows the slope of the roof, being raised a few inches above the slating to keep out the rain-water.

Brass Sash-bars for shop windows are made with a core of wood, covered over by a thin sheet of brass stamped or rolled to various forms and mouldings; they are measured by the foot run, the price varying with the size and character of the moulding.

Stall-board is the framing which forms the part of the shop-front which is below the glass of the window.

Facia is the board placed above the glass of a shop window, and covers up the bressummer.

Dishing is cutting away to a bevel the edges of a hole cut in a piece of wood, as in the seat of a water-closet; the term *dishing-out* is also applied to the formation of *coves* to a ceiling.

Canting is a term used for cutting off the corner of an angular piece of wood or framework.

FLOORS. (Plate 2.)

Floor-boards vary in thickness up to 3 in.; and being always cut out of 2½ in. or 3 in. stuff, they are often described according to the number of saw-cuts required to be made in the original stuff. Thus, when 3 in. stuff is cut into floor-boards by one saw-cut, the floor-boards so obtained are said to be *one-cut* or 1½ in. thick; if by two saw-cuts, they are termed *two-cut* or 1 in. thick; if by three saw-cuts, they are termed *three-cut* or ¾ in. thick. The actual thickness of floor-boards, when laid, is always about one-eighth of an inch less than that by which they are called, on account of the loss by the saw-cut and the planing of one side. Floor-boards are cut out of planks, deals, or battens; but the best floors are made

out of battens, which should be as narrow as possible, since wide boards are liable to warp and become hollow in the middle.

Folding-floors (fig. 1, Plate 2) are laid four boards together, which are shot as nearly as possible to fit a given space, and forced downwards folding into their places. These are the commonest and cheapest kind of floors.

Straight-joint Floors (fig. 2).—The boards are carefully laid the length of the room in regular straight joints, and their *heading-joints* should be either splayed (fig. 6), ploughed and tongued (fig. 7), or executed (as fig. 8), taking care to break them at proper distances. Sometimes the edges are also ploughed, and fastened together with tongues; or else mortised and tenoned by a mortise-groove being cut on one edge, and a tenon on the other edge of each board; these are called *tongued-floors*.

Dowelled-floors (fig. 3).—The boards are laid straight, joined with wood or iron dowels, or pegs let into the edges to confine them down, instead of nails from the face of floors, having them only on the edges of the boards.

Figs. 4 and 5 show the methods of replacing a board in the middle or end of a dowelled floor, should one be damaged, without disturbing the dowels in the boards on either side.

Wainscot-floors should have iron dowels, but deal-floors may have dowels made of beech, as the dowel should certainly be made of a material much stronger than the floor. If beech, they should be formed as

at A, and cut square; and being driven into round holes in the battens makes them draw.

In dowelled-floors the dowels are set from 6 in. to 8 in. apart, and the heading-joints ploughed and tongued; and no heading-joint of any two boards ought to be allowed to meet that of two other boards, or to form a straight line equal to the width of two boards.

Wainscot-floors and first-class deal batten floors should never be laid directly on the joists, but a commoner kind of floor should be first formed, and the finishing one laid in the opposite direction upon it.

PARQUETRY-FLOORS are made with pieces of variously coloured woods, laid in geometrical patterns, and tongued together, a common deal-floor being first laid upon the joists to receive the parquetry.

WEATHER-BOARDING consists of boards nailed lapping one over the other, so as to keep out weather; the boards are generally made thicker at one edge than the other, and are termed *feather-edged boards*; the thick edge of one board is lapped about an inch over the thin edge of that next below it, and the nails driven through the lap.

SOUND-BOARDING consists of short boards placed transversely between the joists, on fillets nailed half way down the joists, for the purpose of receiving a coarse plaster, called pugging, to prevent the transmission of sound from one story to another.

DOORS AND FRAMING.

LEDGED-DOORS are the commonest kind of doors, and are formed by placing boards side by side,

tongued or tenoned one into the other, and fastening them together at the back by horizontal boards called *ledges*. Coach-house doors are also made in this manner, but with upright pieces at each edge framed into the ledges, and cross-braced in addition.

PANEL-DOORS and PANEL-FRAMING consist of vertical and horizontal pieces mortised and tenoned into one another, so as to form rectangular compartments.

The upright and horizontal pieces of any framing are called respectively *stiles* and *rails*, and the thin filling-pieces *panels*. The grooves to receive panels are one-third the thickness of the framing; but the panels themselves may vary from this up to two-thirds thereof, or twice the groove. In this latter case they are *flat* on one side, coming no more forward than the groove; but on the other side they come out to the same plane with the face of the framing, and are called *flush* panels. To obtain the strength of these without their bald flat appearance, the continental artists invented the mode of sloping off a margin all round them, so that the framing, though not more prominent than their centre part, might project and cast shadow on this margin; and these are called *raised* panels. In the richest variety, one or more mouldings separate the margin from the centre, and these are *moulded raised* panels. Panels may also be as thick as the framing, and either *raised on both sides*, or *flush and raised.*

The chief modes of finishing or marking the separation of the framing and panels are these:—

Bead-butt, or Bead and Butt, when the panel's face is flush, and two small round mouldings, or *beads*, are struck along its two lateral edges.

Bead-flush, or Bead and Flush, when similar beads are struck, not on the panel itself, but on the edges of the stiles and rails, so that they form a bead border all round it, mitring at the corners.

Square, when the panel's face is flat, and the framing simply projects before it with a square edge.

Chamfered, when this edge is merely pared off to a narrow diagonal face; and the chamfering is said to be *stopped* when this face does not mitre round the corners, but finishes a little short of them, to avoid weakening the junctions. Stopped chamfers are common in Gothic work, both for edges of panelling and for angles of timbers or posts.

Bead and Flat is when a flat panel is surrounded by a bead, or three-quarter cylinder, wrought on the projecting stiles and rails.

Ovolo and Flat, a convex moulding, whose section is a quarter circle or quarter oval, surrounding a flat panel.

Ovolo and Raised, the same round a raised panel.

Ogee Flat, or Ogee and Raised *Panel*, a moulding of contrary flexure, instead of one only convex.

Quirk Ovolo, or Quirk Ogee, &c., when the curve of either of these mouldings returns inward, after its greatest projection forward.

The general term Moulded will apply to the four

last finishings, or to any in which these mouldings are combined, to whatever extent.

The description of any piece of panelled framing, as a door, &c., may thus be given by describing each side separately, as in the abbreviations about to be proposed.

The panelled construction is properly only adapted to internal doors, for external ones should present, outwards to the weather, as little lodgment, and therefore as smooth a face, as possible; and the natural ornament or relief to the baldness of such a face is obviously furnished by the hinge attachments and other metal work. See Frontispiece.

In doors moulded on both sides, the grooves for panels must be ploughed deeper than the moulding, to prevent light showing through the mitres, should the deals shrink; but if framed with a square back, there is no necessity for ploughing so deep.

As the mouldings, however, are now seldom really part of the work, but imitated on strips of wood stuck on afterwards, the above rule seldom applies.

The joints of panels should be ploughed and tongued.

All tongues should be cut across the grain of the wood.

ABBREVIATIONS.

The same observations respecting abbreviations will hold good, but to a greater extent, with the carpenter and joiner than any of the other trades; and even the most complicated, as sashes and frames,

which may appear at first unintelligible, will very soon be read with as great facility and equal accuracy, with all their varieties, as they could possibly be if written at full length: viz.:—

FOR TIMBER.

L N O	Labour and nails only.	Ro and L	Rough and Labour.
L^r to Q^r P^ns	Labour to Quarter Partitions.	W	Wrought.
		F	Framed.
Fir or Oak { Ro	Cube Fir rough.	B	Beaded.
Fir or Oak { Bnd	Bond.		

Example.

C Fir, W, F, R, & B . Cube Fir, wrought, framed, rebated, and beaded.

FOR DEALS, after describing their thickness.

Inch deal R	Inch deal rough.	D	Dovetailed.
E S	Edges shot.	F	Framed.
W 1 S	Wrought one side.	K	Keyed.
W 2 S	Wrought two sides.	M & C	Mitred and chamfered.
G	Grooved.	S	Sunk.
B	Beaded.	P	Plugged.
P T	Ploughed and tongued.	L	Ledged.

Example.

Inch deal, W 2 S, F & B . . .	Inch deal, wrought two sides, framed and beaded.
Whole deal, W 1 S, P T. . . .	Whole deal, wrought one side, ploughed and tongued.
1½ deal, W 2 S, M & C	1½ deal, wrought two sides, mitred and chamfered.

DOORS.

R, G & L	Rough, grooved, and ledged.	O R P	Ovolo raised panel.
		Q O B	Quirk ovolo and bead.
W, L, R, B	Wrought, ledged, rebated, and beaded.	O G	Ogee.
		Q^k O G	Quirk ogee.
S	Square.	Q^k O G B	Quirk ogee and bead.
B, B & S	Bead, butt and square.	O G F	Ogee flat.
B F^h	Bead flush.	O G R P	Ogee raised panel.
B F^t	Bead flat.	D M	Double margin.
B S	Both sides.	B M	Broad margin.
O F^t	Ovolo flat.		

Example.

$1\frac{1}{4}$ D', W L, R & B door . . .	One and a quarter inch deal, wrought ledged, rebated and beaded door.
$1\frac{1}{2}$ D', 4 P, Q O G & B, & B F door .	One and a half inch deal, four panel, quirk ogee and bead, and bead flush door.

FLOORS.

Inch W D Floor F	Inch white deal floor, laid folding.	Ro, E S	Rough, edges shot.
$1\frac{1}{2}$ Y D, R F Floor	Inch and half yellow deal, rough folding floor.	W F	Wrought, laid folding.
		W S J	Wrought, straight joint.
		D	Dowelled.

Example.

$1\frac{1}{4}$ inch Y deal, W S J floor, H J P T, E N.	$1\frac{1}{4}$ inch yellow deal, wrought straight joint floor, heading joints ploughed and tongued, edges nailed.

SASHES AND FRAMES.

D C frames, O D S sills, W P P, B & P S, $1\frac{1}{2}$ W a & h Sashes, D h, B P, P L & L weights.	Deal case frames, oak double sunk sills, wainscot pulley pieces, beads and parting slips, $1\frac{1}{2}$ inch wainscot astragal and hollow sashes, double hung, brass pulleys, patent lines, and lead weights.

Any variation from this description may be made with ease; viz., if

I B P	Iron box pulleys.	M P P, B & P S	Mahogany pulley pieces, beads and parting slips.
B A P	Brass axle pulleys.		
S H	Single hung.		
C W L	Common white line.	D P P, B & P S	Deal pulley pieces, beads and parting slips.
I P	Iron pulleys.		
I W	Iron weights.		

ON MEASURING CARPENTERS' AND JOINERS' WORK.

There are two methods of measuring carpenters' work: one by taking the superficial contents of roofs, floors, partitions, &c., at per square of 100 feet for the labour and nails, and then the cube

contents of the timber without labour. The other method is, by measuring the cube contents of the timber as cube fir and labour, framed, &c., &c.

If the scantlings of the timber are small or light, it will pay the carpenter best to measure the roofs, floors, &c., as labour and nails, and the timber as no labour. But if the scantlings of the timber are large and heavy, then it will be more to his advantage to measure the work as timber, with the particular labour thereon, as follows:—

If the work is measured as timber and labour, the scantling of each piece is taken as cube fir or oak and labour, and entered accordingly; as

Cube fir, or oak, in ground joists, bonds, lintels, plates, &c., labour and nails included.
Do. framed in roofs, partitions, naked floors, &c., labour and nails included.
Do. . do. . . . truss framed . . . do.
Do. wrought and framed . . . . do.
Do. wrought, framed, and rebated . . . . . . do.
Do. wrought, framed, rebated, and beaded, labour and nails included.
Do. in door-cases.
Oak trusses put into girders, per foot run, stating their size, as 4 in. square, &c.

In measuring for labour and nails to roofs, naked framed floors, ceiling floors, quarter partitions, or any other rough framed work, the dimensions should be taken from the extreme ends of the timber each way, to ascertain the superficial contents thereof, as labour and nails at per square of 100 superficial feet. The openings to chimneys, staircases, &c., are not to be deducted, as the trouble of framing the trimmers and

the joists into those openings is fully equivalent to running the joists through them. The same rule must be observed in taking the labour and nails in quarter partitions, as doors, &c., which must be entered in the measuring-book, and valued according to the description of the work, as follows:—

For Roofs.

Labour and nails to common shed roofing.
Do. . do. with purlins.
Do. . do. with purlins and struts.
Do. . do. common span or valley with purlins and two orders of rafters.
Do. . do. span with collars, dovetailed into sides of principal rafters, and these notched to receive purlins, filled in with common rafters.
Do. . do. framed with principals, king-posts, two struts and purlins, filled in with common rafters.
Do. . do. do. with king and queen posts.
Do. . do. common Mansarde, or curb roof.

For Floors.

Labour and nails to fir ground joists, bedded and not framed.
Do. . do. pinned down on plates and framed to chimneys.
Do. . do. single framed floors, trimmed to chimneys and stairs.
Do. . do. with girders and cased bays.
Do. . do. framed floors with girders, binding, bridging, and ceiling joists.
Do. . do. to common framed ceiling floors, with binding and ceiling joists.

Quarter Partitions.

Labour and nails to common 4 in. quarter partitions.
Do. . do. . 5 in. do.
Do. . do. . 6 in. do.
Do. . do. truss framed with king-posts.
Do. . do. do. with king and queen posts.
If oak is used, describe it.

Having taken the labour and nails, you must then proceed to take the timber therein, which must be entered as cube fir, or oak, without labour.

In roofs, it is customary to take the highest timbers first, as the ridge piece, hips, &c., next the rafters, and so proceed downwards to the ceiling floor.

In partitions, floors, &c., begin with the timbers of the largest scantlings. Wherever a tenon is made, the length must be taken from the ends of the tenon, and not from the shoulders. Likewise the length of joists, including the part in the wall.

In measuring king and queen posts, take the whole length by the scantling of the shoulders. The parallel pieces sawn out for the abutment of the principal rafters must be deducted, should they exceed two feet in length and $2\frac{1}{2}$ inches in thickness; but taken five or six inches short of the length between the shoulders, as the saw cannot enter with much less waste. But if the pieces are less than $2\frac{1}{2}$ inches thick, no deduction must be made, they not being worth more than the labour of cutting them out.

ROOFS.

Hips and valleys to be taken at per foot run, for cutting and waste.

All plates, lintels, discharging pieces, to be taken as bond timber.

Gutter plates, diagonal ties, dragon-pieces or braces, struts, and tie-beams, as fir framed.

Deduct half the length of bond timbers running through openings.

Allow the length of dovetails or scarfing in bond timber, but only taken as bond timber.

Fixing iron straps, screw bolts, hanging ditto, and all iron-work, to be taken and allowed extra.

FLOORS.

Oak trusses, let into breast-summers, to be taken at per foot run.

Oak king or queen posts, let into breast-summers, each at ——.

Girders sawn-down, reversed and bolted, per foot run extra.

Letting in screw-bolts, plates, &c., each extra.

Common or herring-bone strutting between the joists, per foot run extra.

Furrings to ceilings, quarter partitions, battenings to walls, &c., are measured by the square, including labour and nails, and valued according to the thickness of the deals used, from $\frac{3}{4}$ to 3 inches thick. Describe the battening either as framed or nailed only, or if plugged, or if with horizontal backings.

All wall-hooks and holdfasts to be allowed extra.

Centering to groins, vaults, recesses, &c.—Take the depth by the circumference for the superficial dimensions, which is valued at per square for use and waste, materials and time. If taken in this way, the whole of the vaults or recesses must be taken, although the same centering might have been used.

But where there are a number of vaults or recesses of the same size, the fairest way is to allow the whole of the materials and time, or, if any trifling alteration only is wanted, to allow the time expended in doing it.

If to small openings, as windows, recesses, doors, &c., they may be measured at per foot superficial, viz.:—

ft. in.	ft. in.		ft. in.
3 6			
0 4		Superf. of centering to apertures, as windows, &c. (Plate 3, fig. 1 A.)	
12 10			8 2
0 9			4 1
			0 7
16 10			12 10
1 10		Superf. of semicircular centering to revealed windows. (Plate 3, fig. 2 B.)	
			10 8
			5 4
			0 10
			16 10

Bracketing to cornices (Plate 3).—To be measured at per foot superficial, according to the girt, viz., 24½ inches by the length, as whole or 1½ inch deal, according to the thickness of deals used. Some allow the bracketing the same girt as the cornice.

inches.
6
1½
9
6½
1½
24½

Cradling for entablatures over shop windows, &c., measured and charged per foot superficial, according to their thickness.

All circular bracketing, cradlings, &c., to be charged double those of straight work.

Ashlering at per foot superficial, according to the thickness of the deals used.

ft. in.	ft. in.	
20 0		Supposed length } (See Plate 3, fig. C.)
2 0		Height . .

Gutters and bearers (Plate 3, fig. C).—Measure the length, then the breadth of the bottom and half the eaves-board.

Gutters between the roofs having two eaves-boards, one on each side, take for the width of gutter one of them. (Fig. D.)

ft. in.	ft. in.		
20 0		Supposed length	Enter them as— Superf. of whole deal gutters and bearers.
1 1½		Width (fig. C.)	
20 0		Do. (fig. D.) .	
1 6			

Arris or fillet gutters per foot superficial.

Water trunks per foot run ; describe size, and allow for laps and half the length of shoe.

Sound boarding.—Measure the dimensions between the joists at per foot superficial, observe if single or double fillets.

Chimney grounds, per foot superficial. (Plate 3, fig. E.)

ft. in.	ft. in.	
4 6		Enter them as 1¼ inch framed grounds, or the thickness, as the case may be.
4 0		
3 9		DDt. opening.
3 3		

Or they may be taken as—

ft. in.	ft. in.	
2)3 9		
0 4½		Framed grounds.
4 0		
0 9		

If the side grounds are very narrow, framed only for small mouldings, take them by the foot run, and enter them as narrow framed grounds.

Hinges to be numbered and described.

Skirtings, either plain or raking, taken at per foot superficial.

If raking, to be taken for the width as per sketch. (Plate 5, fig. B.)

If on narrow grounds, take them per foot run.

If plugged to the walls, allow extra for plugging.

Moulded plinths.—Measure the square part by the length and width, and enter it—Whole deal, wrought one side, rebated and backed plinth. Girt the moulding, and allow half an inch behind the plinth. (See Dado, Plate 3, fig. n.)

Pilasters.—Girt and enter them thus:—

ft. in.	ft. in.	
7 6		1½ inch deal, glued and blocked pilasters, framed Qk O G, or ovolo and bead, as may be. (Plate 3, fig. 3.)
2 0		
2 6		Moulded impost { ft. in. 0 6, 0 3 = 0 9 }
0 9		

The plinth may be measured in with the pilaster.

Flooring (Plate 2).—In measuring boarded floor-

ing, the dimensions must be taken, allowing the thickness of the skirting, and valued at per square.

Enter them in your book according to their thickness, and if yellow or white deal, if common or second-best or clean deal; if laid folding, straight-joint or dowelled.

The slabs are not generally deducted if they have mitred borders; if they have not mitred borders, deduct the opening or slab from the flooring. If the deduction is made when there are borders, the borders must be taken at per foot run, which will amount to as much as the deduction made on the floor.

Mouldings, such as architraves, round doors, windows, &c., base, surbase, &c., &c., are to be measured round the mitres and girt with a fine tape, and entered as moulded architrave, base, &c., as the case may be. But in the abstract they must be all classed under the same head as mouldings.

Single mouldings, as Q[k] O G and bead, or Q[k] ovolo and bead, &c., may be taken at per foot run, but their girt must be described, as they will be valued accordingly.

Doorcases, linings, &c., &c. (Plate 4).—Doors are measured and valued at per foot superficial, according to their description. Solid doorcases are taken at per foot cube.

Door linings, grounds, &c., at per foot superficial, as follows:—

Solid doorcases and doors.

ft.	in.	ft.	in.		ft.	in.	ft.	in.
19	2				6	8	7	3
0	9				0	5	7	3
0	5				0	2		
				C O W R & B[d] Doorcase, (fig. 1)				
					3	4		
					0	10	4	8
					0	6		
							19	2

If there is a sill, take it the same as the head, viz., by making an allowance for its passing under and beyond the jambs, as may be; and also allow the additional length of jambs for framing into ditto. If a stone sill, iron shoes should be secured to the bottom of jambs, which must be numbered.

ft.	in.	ft.	in.	
6	8½			W[h] Deal, 2 S L, R & B[d] Door, size including the rebates. (Fig. 1.)
3	5			
				Number the bolts, and enter the hinges per pair.

Doors with linings (Plate 4).

ft.	in.	ft.	in.		ft.	in.	
				Whole deal 4 P, Q O G & b and B F Doors (fig. 2, and A, fig. 3, 4, 5), or as it may be. But the door must be taken first between and including the rebates.	6	8	
6	8				6	8	
3	1				3	1	their thickness.
					0	2	
					16	7	Twice the width of grounds.
16	7			2nd. The linings by calculation.	0	9	
0	6½						
				W[h] deal, P F B & b lining (as B, fig. 3 and 4).	17	4	One face of architrave for mitres.
17	4				0	8	
0	4½			3rd. The grounds, viz.—Inch deal framed grounds. (D, fig. 3, 4, 5.)	18	0	
18	0			4th. Architraves.—Superf. moulded architraves. (C, fig. 3, 4, 5.)			
0	9						

If mitred and block plinths, number them, but observe to take the architraves short.

Number the locks, hinges, bolts, &c., describing them.

Fig. 3 and 4, the common methods for doors in partitions: No. 4 has the preference. Fig. 5, for doors Q O & b[d] b s in walls, consequently wide linings framed in panels to answer them.

Dado (see Plate 3). Elevation and section, showing base and surbase-moulding, plinth, &c., and that the heading-joints should be broken, as they are in a straight-joint floor. By the narrow grounds K, tongues I, and keys G, the dado hangs unconfined, the joints being also secured by slips ploughed and glued into the back, as at H, and dovetailed pieces inserted at regular distances, as at M, the top and bottom of dado not being confined, and the joints thus secured, there will be no danger of the joints opening, even should the deal shrink. The tongues, I, through the grounds, K, should be about three feet asunder, as also the keys, G; these must be about three inches wide at the bottom. The heading-joints should be ploughed and tongued.

B, the common, though bad method of rebating the dado into the grounds.

E, fillet in floor to secure plinth.

F, the best method, by grooving the plinth into floor. The angles of all dados must be grooved.

Measure the height of dado within half an inch of the top of surbase, as it will do for dado and grounds; then take superf. of moulded base and surbase mouldings; girt the surbase from plastering to face of dado, and the base from dado to top of plain plinths; then add half an inch for rebate. Enter the dado according to its description, viz.:—

As inch deal keyed dado.
Do. dovetailed at the back, with grooved rail, or as the case may be.
Do. do. raking.
Do. do. circular on the plan, grooved and backed on the cylinder.
Do. do. wreathed.
Number each external mitre.

Sashes and frames, shutters, and fitting up to windows (see Plate 4).—Take the dimensions from the beads of sashes on the inside, and allow seven inches additional height for head and sill, and eight inches in width for frames in common sashes; but nine inches for large sashes.

ft. in.	ft. in.		ft. in.
9 1 4 10		(Fig. 7) D C F, O S sills, W P P, B & P S . .	8 6 0 7 9 1
		2 in. W a & h sashes, D h, B A P, P L, L W .	4 2 0 8 4 10

French sashes, or casements, hung on hinges, or sashes hung on centres in solid frames.—Take the sashes separate, and the frames as directed for doorcases. If Venetian frames, describe them as such.

If mouldings up mullion, take them per foot run.

If circular heads, take the sash by itself, and the frames as run of circular frames, as per description; viz., with beads, parting slips, &c., &c., as may be.

Window shutters are taken per foot superficial, allowing for the rebates.

Number the sash fastenings, locking bars, spring latches, hinges, &c., &c.

The framed grounds, rebated and beaded boxings, linings, moulded architraves, &c., are taken per foot superficial, similar to the doors, viz.:—

ft. in.	ft. in.		
		(Fig. 8.)	ft. in.
2)8 8 0 11		1¼ Dl. 4 Panl. Q O b & b b shutters, (E) hung in two heights.	8 6 { top and bottom bds. 0 2 8 8
2)8 8 0 9½		Do. Back flaps (F).	
2)8 8 0 6½		Inch deal, do. do. (G).	
		N. 4 pair 2½ butts. 8 pair back flap hinges. 1 locking bar. 2 brass knob spring latches. 1 patent sash fastening.	
2)8 10 0 10½		1¼ deal, 4 panel, b b, back lining (H).	8 8 0 2 8 10
4 10 0 11		1¼ deal, Q O & B soffit (fig. 6, L)	4 2 0 8 4 10
6 2 2 6		1¼ deal, 3 panel, Q O b backs and elbows (fig. 6 and 7, K.)	4 4 0 11 0 11 6 2
4 4		Run of slit deal, beaded capping to back.	
		No. 2. Caps and elbows.	
2)11 2 0 5		1¼ deal splayed and framed boxings (fig. 8, L).	8 8 2 6 11 2
5 2 0 5		1¼ deal framed grounds (fig. 6, N).	4 4 0 10 5 2

ft.	in.	ft.	in.		ft.	in.	
					11	2	width of architrave.
					0	6½	
27	5				11	8½	DDt. ht. of plinth.
0	9				0	8½	
				Moulded architrave, M.			
				1 pair of mitred and blocked plinths 8½ in. high.	11	0	
					11	0	
					4	4	width of architrave.
					1	1	
				If boxings are executed, as shown at L (fig. 10), they must be taken as splayed, framed, rebated, and beaded boxings, per foot superf., and the mouldings forming the architrave at per foot run.	27	5	

Staircases (Plate 5) are taken per foot superficial, by girting the riser and tread by the length of the step, allowing extra for the thickness of the skirting, which is entered in the measuring-book according to their thickness and description, viz., inch deal common steps, risers, and carriage.

1¼ inch deal second-best, steps, risers, and carriage, with moulded nosings, close or cut string; or,

1¼ inch deal second-best, S R & C, M nosings, mitred to receive brackets or string boards and return nosings, and dovetailed to receive balusters.

1¼ inch clean deal, do., do.

1¼ inch clean deal, S R & C, to geometrical stairs on a circular plan, the risers mitred to the string board.

METHOD OF MEASURING STEPS, RISERS, AND CARRIAGE.

ft.	in.	ft.	in.		ft.	in.	
3	6			Length of tread.	0	10	
1	5			Supr. 1¼ deal, S R & C to fliers (fig. B & C)	0	7	
				If geometrical winders (as plan A), consequently wrought and blocked carriages (as fig. F and G), they must be taken thus, and described as such :—	1	5	
7	2			Winders with circular ends. (Enter description.)			
3	9						
					0	7	Project. of nosing.
27	10			Risers, the lengths collected . .	0	1	
0	8				0	8	
1	2			DD$^{s.}$ opening.			
1	6						
9	6			Whole deal framed string.			
0	10¾						
4	4			Whole deal apron, 2 sides (fig. D.)			Return landing.
0	9			¾ do. ploughed in (fig. E.) . . .			
4	4						
0	4½						

N.B. All winders must be taken as before described.

Fig. F shows a single wrought and blocked carriage for a geometrical winder; G, a set of do. as fixed; the dotted lines show the fronts of steps.

If moulded return nosings, or brackets, either straight or circular, number them.

Iron balusters, do.

Block steps, do.

Veneered curtails, do. (Plan of do., fig. H, showing the manner of veneering it; I, section of wedge.)

Turnings to newels, do.

Pendent drops, do.

Handrails, either straight, ramped, or wreathed, per foot run.

Planceers, newels, bar balusters, &c., do.

ROTATION.

In measuring the carpenters' work of a building, it is usual and customary to begin with taking the roof; then the plates, bond timbers, &c., next the quarter partitions; then the naked floors under ditto. If it is determined to take the timber in the above without labour, then the labour and nails at per square must be measured as such before the cube timber is taken.

In measuring joiners' work, on entering each room, first take the boarded floors, then the dado or skirting, next the battening or bracketing, if any, then the chimney grounds and chimney pieces, next the windows, as sashes and frames, linings, boxings, grounds, architraves, &c., and last the doors, linings, grounds, architraves to ditto, &c., &c.

ABSTRACTING.

In abstracting carpenters' and joiners' work, the greatest possible care must be taken to prevent confusion, for when several thousand dimensions have to be entered under their respective heads, unless a regular rule be observed in drawing out the abstract, and placing every description of work in the situation usually allotted to it, much time would be consumed in referring to the different heads.

Proper attention to the form here given, for abstracting the quantities and bringing the different articles into bill according to their regular rotation,

will prevent the student from experiencing this inconvenience.

The abstract for carpenters' and joiners' work should be made on very large paper, and care taken to give sufficient length in each column for all the dimensions that it may be requisite to enter in them. The deals, as shown in the lower range, should be put on the other side, or on another sheet of paper, under their respective thicknesses. The partitions, backs and elbows, soffits, dados, columns, pilasters, stairs, strings, gutters and bearers, &c., &c., should be placed. It is also better, in abstracting the work of a large building, to keep the ironmongery on another paper, as every care should be taken to keep all the articles and entries separate and distinct.

Abstract of Carpenters' and Joiners' Work

Abstracted with Mr. X. Y. Z., January 1st, 1870.

PER SQUARE.													
LABOUR AND NAILS.			FURRINGS AND BATTENINGS.			BOARDING.		FLOORING.			OAK.		
Qr. P.	Roofs.	Floors.	¾ in.	2 in.		Ro.	Weather.	White Inch.	Yellow Inch. Ro.	Inch Wrot. Foldg.	Cube No labour	Plank 1 in.	2½ in.
			1 in.	2½ in.		W 1 S							
							Sound.				Do. labour	1½ in.	3 in.
			1½ in.	3 in.		W 2 S							
								1¼ in.	1¼ in.	1¼ in. Wrot. S J	Wrot.	2 in.	4 in.
											Wrot. and framed		

SLIT DEAL.			¾ IN. DEAL.			INCH DEAL.			1¼ IN. DEAL.			1½ IN. DEAL.		
Ro.	1 S	2 S	Ro.	1 S	2 S	Ro.	1 S	2 S	Ro.	1 S	2 S	Ro.	1 S	2 S

done for A. B. by C. D.

	Fir.			Window Shutters.	Doors.	Sashes.	Frames.	Sashes and Frames.	Mouldings.	Runs.
	Cube No labour.	W & F				1½ in. Dl. ovolo.	D C F O S sill W P P B & P S			
		W F R & Bd								
	And labour.					2 W ovolo.				
	Wrot.			Wainscot.	Mahogany					

	2 in. Deal.			2½ in. Deal.			3 in. Deal.			Ironmongery.				
	Ro.	1 S	2 S	Ro.	1 S	2 S	Ro.	1 S	2 S	Screws	Bolts	Hinges	Locks	Rings Sundries

ROTATION

To be attended to in bringing the quantities into Bill.

Carpenter and Joiner.

Sqrs. ft. in.				
	Labour and nails to roofs, according to description . .			
	Do. . do. to floors, naked framed do.			
	Do. . do. to quarter partitions			
	Inch deal furrings, according to description			
	Do. battenings . . . . do.			
	Do. rough boarding . . do.			
	Do. wrought do. . . do.			
	Do. weather do. . . . do.			
	Inch folding floors . . do.			
	And the other floors, beginning with the inferior and finishing with the best, and so on for any other articles valued at per square.			
	Then the cubes, as—			
Ft. in. ps.				
	Cube oak, no labour . . .			
	Do. bond			
	Do. wrought, &c., &c. . .			
	Cube fir, no labour . . .			
	Do. bond			
	Do. wrought and framed, &c., &c.			
	Cube fir, wrought, framed, and rebated			
	Do. proper doorcases, or any other, according to the work thereon			

Ft.	in.			
		After the cubes, then the work valued at per foot superf., viz.:—		
		Superf. of inch oak plank, *then the other thickness of oak plank, with the labour, &c.* . . .		
		Superf. of ½ in. deal rough, labour and nails . . .		
		Superf. of do. wrought one side		
		Superf. of ¾ in. deal, *and proceed to the thicker deals, with their labour, as the case may be, commencing with the thinnest, and proceeding in regular succession, according to their thickness and the labour thereon*		
		Then the framed work, as—		
		Inch deal square framed partitions		
		Next the doors, as—		
		1¼ in. 4 panel bead flush and square doors		
		Then the windows, viz.:—		
		Inch deal bead butt back linings, quirk ogee and bead backs, elbows, and soffits . . .		
		Shutters—		
		Bead butt back flaps, quirk ogee and bead shutters, &c., &c.		

Ft.	in.				
		Sashes and frames—			
		$1\frac{1}{2}$ in. deal ovolo sashes . .			
		Deal cased frames and sashes, according to their descriptions			
		Then—			
		Superf. of mouldings			
		The work per foot run . . .			
		Do. numbered			

VALUATION OF CARPENTERS' AND JOINERS' WORK.

MEMORANDA.

50 cubic feet of timber equal one load.

100 feet superficial equal one square.

120 deals are called one hundred.

A reduced deal is $1\frac{1}{2}$ inch thick, 11 inches wide, and 12 feet long.

120 12-feet 3-inch deals equal $5\frac{2}{5}$ loads of timber.

400 feet superficial of $1\frac{1}{2}$-inch plank or deals equal one load.

Planks are 11 inches wide; deals, 9 inches; and battens, 7 inches or less.

A square of flooring requires:—

	Number of 12 ft. boards.
Laid rough	$12\frac{1}{4}$
Do. edges shot	$12\frac{1}{2}$
Wrought and laid folding	13
Do. . straight joint	$13\frac{1}{2}$
Do. . do. and ploughed and tongued .	14

	Number of 12 ft. battens.
One square of wrought folding floor requires . .	17
Do. straight joint	18

WEIGHT OF TIMBER.

39 cubic feet of	oak	. equal	.	1 ton.
65 ,,	fir	. ,,	.	do.
66 ,,	deals	. ,,	.	do.
60 ,,	elm	. ,,	.	do.
51 ,,	beech	. ,,	.	do.
45 ,,	ash	. ,,	.	do.
34 ,,	mahogany	,,	.	do.

CALCULATION, showing the method of ascertaining the VALUE of a CUBIC FOOT of FIR or other Timber from the prime cost prices :—

	£	s.	d.
Fir timber, at per load, say	5	0	0
Carriage (according to distance)	0	5	0
Sawing, on an average	0	10	0
	5	15	0
Waste in converting $\frac{1}{10}$	0	11	6
	6	6	6
20 per cent. profit	1	5	3½
	7	11	9½

$$\frac{\text{£ 7 11s. } 9\tfrac{1}{2}d.}{50}$$ or 3*s.* 0¼*d.* per foot cube.

The constants in the following tables are to be multiplied by the rate of wages for a carpenter per day.

LABOUR AND NAILS TO ROOFS.

At per square of 100 superficial feet.

	Labour. Days.	Nails. s.	d.
To common shed roofs, one story high . .	·650	2	0
Do. do. with purlins	·800	2	0
If two stories, add	·084		
If three do., add	·169		

	Labour. Days.	Nails. s. d.
Common span or gabled roof, with purlins, and principal and secondary rafters, two stories high	1·000	2 0
If three stories, add	·084	
Framed roofs, with collars dovetailed into sides of principal rafters, and these notched to receive purlins, and filled in with common rafters	1·906	3 6
Roofs framed with principals, king-posts, purlins, braces, and common rafters . .	2·940	4 0
Do. do. with king and queen posts. . .	3·170	4 0
Mansarde or curb roofs on one side . .	1·125	2 0
If two sides, add	·084	
If three sides, add	·169	
If above two stories, add	·100	

LABOUR AND NAILS TO NAKED FLOORS.

At per square of 100 superficial feet.

Ceiling floors, joists only	·584	1 6
Do. framed with tie-beams	·834	1 9
Do. with binding and ceiling joists . .	1·000	1 11
Ground joists, bedded but not framed . .	·500	1 6
Do. pinned down on plates and framed to chimneys	·836	1 6
Single framed floors trimmed to chimneys and stairs	1·050	1 9
If above 9 in. deep, add.	·169	
Framed with girders and cased bays . .	1·700	3 0
Framed with girders, binding, bridging, and ceiling joists	2·500	4 0

LABOUR AND NAILS TO QUARTER PARTITIONS.

At per square of 100 superficial feet.

Common 4 in. partitions	·900	1 3
Do. . 5 in. do.	1·050	1 6
Do. . 6 in. do.	1·100	1 6
Truss framed with king-posts	1·736	1 6
Do. with king and queen posts	2·000	4 0

If oak, one-third extra.

LABOUR ON FIR TIMBER.

At per foot cube.

	Days.
Cube fir bond	·063
Do. framed	·126
Do. truss framed	·168
Do. framed and chamfered	·168
Do. wrought and framed	·210
Do. do. and rebated	·252
Do. W, F, R, and beaded	·294
Do. W, F, R, and D beaded	·336
Do. proper doorcases	·378
Planing fir, per foot superf.	·014

Bond timbers, wall plates, wood bricks, pole and curb, &c., are all to be under the head of bond.

CALCULATION, showing the method of finding the VALUE of DEALS or BATTENS from the prime cost prices.

	£	s.	d.
Prime cost per hundred of 12 ft. 3 in. deals, say	35	0	0
Carriage, according to distance	0	10	0
	35	10	0
20 per cent. profit	7	2	0
	£42	12	0

£ s. d.
42 12 0
——— or 7*s.* 1*d.* to be allowed in day-bills for
120

each 3 in. deal	0	7	1
In measured work, allow for waste $\frac{1}{10}$	0	0	8½
	0	7	9½

In calculating the value of deals in thicknesses, add the value of the sawing, according to the number of cuts.

Every rise and fall of 9*l.* per hundred, will increase or diminish the price of deals as nearly as possible, per

foot superficial, 1*d.* per inch in thickness. This rule will be found sufficiently correct for practice where the quantities are not large; where they are, the exact calculation should be made.

LABOUR ON DEALS, AT PER FOOT SUPERFICIAL.

In order to facilitate the fixing of proper prices for the labour on deals, at per foot superficial, the different descriptions of work which have always been considered of equal value are classed together, by which the system adopted for valuing the various sorts of labour on deals will be rendered more simple and easy. Over the column in which is inserted each kind of work of equal value, is placed the decimal which, multiplied by the rate per day allowed for a carpenter at the time and place where the work is performed, will show the fair and equitable price to be allowed.

	No. 1.	No. 2.	No. 3.	No. 4.
For deals from ½ to 1½ in. thick	·009	·019	·027	·037
For deals from 2 to 3 in. thick	·013	·027	·037	·049
	Edges shot Plugged Jacked Rounded	Labour and nails Planing on each side Grooved Rebated Ploughed and tongued Framed Battened Mitred Scribed Backed Throated Clamped Beaded	Cut circular	Cut standards Sunk shelves Scolloped Ledged Dovetailed

BATTENING, PER SQUARE.

	Labour. Days.	Nails. s.	d.
¾ in. to 1¼ in. placed 12 in. from centre to centre	·590	2	0
If plugged to walls, add	·170	1	0
Extra for wall hooks.			

WEATHER BOARDING, PER SQUARE.

Rough	·420	2	6
Do. splayed edges	·680	3	0
Wrought	1·000	3	3
Do. and beaded	1·255	3	6

ROUGH BOARDING, PER SQUARE.

¾ in. deal, rough	·500	2	6
Do. . edges shot	·667	3	0
Do. . ploughed and tongued	·750	3	0
Inch deal, rough	·542	2	9
Do. . edges shot	·709	3	0
Do. . ploughed and tongued	·918	4	0
Whole deal, rough.	·584	3	0
Do. . edges shot	·750	3	6
Do. . ploughed and tongued . .	1·042	4	0
1½ in. deal, rough	·667	3	0
Do. . edges shot	·862	3	6
Do. . ploughed and tongued	1·167	4	0

DEAL FLOORS, PER SQUARE.

Inch, rough edges shot	·765	2	6
Do. wrought folding	1·180	2	6
Do. do. straight joint	1·500	3	6
Whole deal, rough edges shot	·840	3	0
Do. . wrought folding	1·255	4	0
Whole deal, wrought straight joint, splayed headings	1·760	4	6
Do. . . do. dowelled	3·170	8	0
1½ in. deal, rough edges shot	·920	3	0
Do. . wrought folding	1·340	4	0
Do. . do. straight joint, splayed heading	2·000	4	6

	Labour. Days.	Nails. s. d.
If ploughed and tongued headings, add	·295	
If ploughed and tongued edges, add	·510	
For tongues to edges of boards, add	·840	

BATTEN FLOORS, PER SQUARE.

Inch, wrought folding	1·500	4	6
Do. straight joint, splayed headings	1·792	4	9
$1\frac{1}{4}$ in. wrought folding	1·667	6	0
Do. straight joint, splayed headings	2·167	6	3
Do. dowelled	4·167	10	0
If ploughed and tongued headings, add	·431		
If ploughed and tongued edges, add	·750		
For tongues to edges of boards, add	1·250		
If battens less than 5 in., add	·334		

FRAMED GROUNDS, PER FOOT SUPERFICIAL.

	Labour and Nails.
Common framed grounds	·063
1 in. do. ploughed for plastering	·070
$1\frac{1}{4}$ in. do. do. do.	·076
$1\frac{1}{2}$ in. do. do. do.	·083

SKIRTINGS, PER FOOT SUPERFICIAL.

Plain skirting	·037
Do. raking cut to steps	·070
Torus skirting	·065
Do. raking cut to steps	·085

GUTTERS AND BEARERS, PER FOOT SUPERFICIAL.

Inch or whole deal	·076

DOOR LININGS, PER FOOT SUPERFICIAL.

Plain single rebated	·056
Do. and beaded	·063
Do. double rebated	·070
Do. do. and double beaded	·077
Square framed jambs, each in 2 panels and soffit in 1 panel	·105

	Labour and Nails.
If bead butt, or moulded, add	·013
Bead flush, or quirk moulded	·027
Raised panel and moulded	·042
For every extra panel if square	·021
Do. flush or moulded	·027
If double rebated	·021
If double beaded	·013

LEDGED DOORS, PER FOOT SUPERFICIAL.

1¼ in. rough edges shot	·065
Add,	
If ploughed and tongued	·013
If ploughed and beaded	·021
If wrought each side	·013
If braced	·027
If hung folding	·021
If 1 in. thick	·013

FRAMED PARTITIONS, PER FOOT SUPERFICIAL.

1½ in. square framed	·065
2 in. do.	·076
Add,	
If B B or moulded	·027
If B F or quirk moulded	·042

DEAL MOULDINGS, FIXED COMPLETE.

Common mouldings	·128
Add, if quirked	·028

The materials for mouldings in deal will be found as near as possible of the same value as the labour. Small mouldings may be measured at per foot run, and valued according to the girt and form.

DOORS HUNG COMPLETE, PER FOOT SUPERFICIAL.

	Labour and Nails.
Two-panel square framed	·070
Add, for every additional two panels:	
If framed square,	
For 1½ in. deal	·019
2 in. do.	·021
2½ in. do.	·027
Add, for every two panels:	
If framed B B and square—For 1½ in. deal	·021
2 in. do.	·024
2½ in. do.	·027
If framed B F and square—For 1½ in. do.	·027
2 in. do.	·037
2½ in. do.	·042
If framed Qk. O G and Bd. and square, or Q Ov. and Bd. and square—For 1½ in. deal	·021
2 in. do.	·024
2½ in. do.	·027
If double margins 4½ in. wide	·021
Do. 5½ or 6 in. do.	·042
Hung folding	·013

WINDOW LININGS, PER FOOT SUPERFICIAL.

Inch deal two-panel square framed back linings	·101
If B B, or moulded, add	·013
B F, or quirk moulded, add	·021
For each panel above two, if square	·021
Do. do. if moulded	·027
If splayed linings, add	·007

WINDOW BACKS, ELBOWS, AND SOFFITS, PER FOOT SUPERFICIAL.

Inch deal, plain keyed or two-panel square backs	·085
Do. two-panel square backs, elbows and soffits	·098
Add for each panel above three,	
If splayed	·010
If bead butt, or moulded	·013
B F, or quirk moulded	·021

BOXING TO WINDOWS, PER FOOT SUPERFICIAL.

	Labour and Nails.
Framed, rebated, and beaded boxings	·101
Splayed F R and beaded boxings	·120

INSIDE WINDOW SHUTTERS, PER FOOT SUPERFICIAL.

$\frac{3}{4}$ in. deal clamped flaps in one height	·120
Inch do. two-panel square in one height . . .	·125
For every panel above two add,	
If framed square	·022
If B B, or moulded	·022
B F, or Qk. moulded	·026
Q O G & b, or Q O & b & square	·026
For every extra height, add	·013

SASHES AND FRAMES HUNG COMPLETE, PER FOOT SUPERFICIAL.

Sashes—

$1\frac{1}{2}$ in. deal ovolo sashes	·049
Do. wainscot or mahogany	·070
If 2 in. or $2\frac{1}{2}$ in. sashes deal, add	·021
If do. wainscot or mahogany, add	·028
If astragal and hollow in deal, add	·013
If do. in wainscot or mahogany, add	·021

Frames—

Deal cased frames O S sills, D P P B & P S, S hung .	·070
If prepared for 2 or $2\frac{1}{2}$ sashes, add	·013
If prepared with wainscot or mahogany P P Bds. & P slips, add	·085
If for 2 or $2\frac{1}{2}$ in. sashes, add	·019
If double hung, add	·013

To find the value of sashes and frames, add to the above for labour and nails only, the amount of materials expended.

STAIRCASES, PER FOOT SUPERFICIAL.

	Labour and Nails.
Common steps and risers and two fir carriages	·070
Do. moulded nosings and close strings	·098
Do. do. mitred to cut string boards (to imitate stone steps) and dovetailed to balusters	·127
Add, if winders circular at one end	·042
Do. circular at two ends	·085
Do. geometrical, with wrought and blocked carriages	·056
Riser tongued to step bottom edge	·021
Do. do. both edges	·042
Feather tongued joints	·021
Add for each,	
Quarter curtail glued upright	·667
Do. blocked and veneered	1·167
Proper curtail step and riser	3·334
Returned moulded nosing (to imitate stonework)	·250
Do. circular	·417
Plain cut bracket	·250
Do. circular	·417
Housing to step and riser	·098
Do. to winders	·125
Do. to moulded nosings	·167
Do. to do. circular ends	·459

OUTSIDE STRINGS TO STAIRS, PER FOOT SUPERFICIAL.

Whole deal, plain	·084
Do. sunk	·098
Do. sunk and moulded	·112
Do. do. cut (i.e., to imitate stone steps)	·127
Do. do. mitred to risers	·140

If ramped (but in one plane), once and a half the above.
If wreathed, four times.

WALL STRINGS, PER FOOT SUPERFICIAL.

Plain and plugging	·080
If moulded, add	·021
If rebated for plastering, add	·028

DADOS, PER FOOT SUPERFICIAL.

	Labour and Nails.
Proper dado, with dovetailed keys, joints secured with slips, and dovetails hung to grounds by keys grooved into do. and dado	·070
Add,	
If raking scribed to steps	·019
Do. to moulding nosings	·021
If base grooved into floor	·009
For each external mitre beyond two in the room . .	·228
If circular on the plan,—double the above.	
If wreathed do.,—treble do.	

IMITATIONS OF COLUMNS AND PILASTERS, PER FOOT SUPERFICIAL.

1¼ in. deal plain pilasters, properly glued and blocked .	·112
Do. do. diminished	·153
1¼ in. deal diminished columns, properly glued and blocked, under 14 inches diameter	·420
Do. do. above do.	·350
Add for,	
Arris or deep fluting to pilasters, one inch wide . .	·021
Do. two inches wide	·028
Ditto three inches wide	·042
Arris or deep fluting to columns, one inch wide . .	·027
Do. two inches wide	·042
Do. three inches wide	·056
Straight grooves to columns	·021
Headings to flutes to do.	·070
Straight grooves to pilasters	·013
Headings to flutes to do.	·042

SAWYERS' WORK.

The charges for sawyers' work are often very inconsistent, and differ widely in various parts of the country. They also vary according as the work is done by hand or by machinery, which latter mode is most commonly used, there being less waste in machine-sawing than in hand-sawing.

The proper mode of valuing the labour on sawing fir or any other kind of timber is by the square of 100 superficial feet, the price depending on the usual rate of wages and the hardness of the timber.

Sawing to old timber is usually charged double, on account of the extra labour occasioned by nails, &c.

Small scantlings may be charged by the foot run.

Planks, deals, battens, and flat cuts, according to their length, at per dozen cuts.

And all other descriptions of sawyers' work may be valued in a similar manner, according to the circumstances of the case.

CHAPTER V.

MASONRY.

TECHNICAL TERMS AND EXPLANATIONS.

THE term MASONRY is generally applied to the art of building with stone laid in mortar or cement; it is also used in a restricted sense as applying only to the parts of a building in which worked or *hewn* stone is employed, as in the formation of arches, piers, and walls, built with solid blocks of stone.

BUILDING STONES, or stones used for ordinary building purposes, may be divided into five classes; namely, Granites, Sandstones, Limestones, Oolites, and Magnesian Limestones.

GRANITE is one of the hardest, strongest, and most durable of the building stones, having a crystalline character, but varying greatly both in durability and weight, according to its composition. Its chief components are quartz, felspar, and mica; and the durability very much depends on the proportions in which these minerals are combined; those granites which contain a large proportion of felspar being rapidly decomposed by the action of the weather,

since that mineral contains a considerable proportion of clay. The red colour which some granites possess is owing to the presence of the oxide of iron.

The granites used in this country are principally obtained from Guernsey, Cornwall, and Scotland; the most durable and useful for building purposes being found in the neighbourhood of Aberdeen, which weighs about 166 lbs. per cubic foot, and has a resistance to crushing of 10,000 lbs. per square inch. The use of granite, on a large scale, is confined to the building of walls for river embankments, piers, and arches of bridges, and for other engineering purposes, where great power of resistance to weather, or to the action of water is required. For ordinary buildings, it is only employed where no other material is obtainable, on account of the great difficulty in working it. As, however, it is capable of taking a beautiful polish, which is not injured by exposure to weather, it is occasionally used in the ornamental features of first-class structures.

Cornwall supplies a large quantity of very excellent granite, that from the Cheesewring quarries near Liskeard being much used for engineering purposes. It is of a light greyish colour, and weighs 166 lbs. per cubic foot. Granites of good quality are also obtained from Devonshire, as that from Hay Tor near Teignmouth, which is fine-grained, hard, and durable. Its colour is a bluish grey, and its weight 165 lbs. per cubic foot. Lundy island, off the coast of Devon, also supplies a good grey granite. An excellent granite for paving purposes is obtained from Caernar-

vonshire, weighing 160 lbs. per cubic foot. By far the largest quantity and best quality of granites are obtained from Scotland, especially from Aberdeenshire. These are of various tints—grey, blue, red, and pink. Granites of the latter tints are found in the island called Ross of Mull, and resemble the Aberdeen in quality. On the south-west coast of Scotland good grey granite is obtained from Wigtown Bay, and also from Dalbeattie, near Dumfries. Ireland supplies a considerable quantity, that from the neighbourhood of Wicklow and Dublin being a speckled grey; and from Galway a reddish granite is obtained. Carlow also supplies several varieties of granite. The Dublin stone weighs 169 lbs. per cubic foot.

For curbs the granite obtained from the islands of Guernsey and Jersey, and also from Aberdeen and Devon, is generally used; and for paving in blocks or *pitching* to roads subjected to heavy traffic, the Aberdeen granite is found to be most durable, being used in blocks from 12 to 18 inches long, 3 inches thick, and 9 inches deep. For macadamised roads the Guernsey granite answers best. The following terms are used in Aberdeenshire for worked granite: *Hammer-blocks* are used only for basement stories, foundations, and underground work. *Scappled-blocks* are squared with a heavy pick, and employed for engineering purposes. *Rough-picked* is finished better than the last, but used for similar works. *Close-picked* has the beds and arrises worked fair, the face being finely worked by the pick: this is used for

ashlar facing. *Single-axed* is finished finer than the last, and used for dressings and moulded works to buildings. *Fine-axing* is the highest finish that can be given to granite by means of the axe. The working of granite must be done by men especially trained to the use of that material.

SANDSTONES are minerals composed almost entirely of silica or sand, with a small proportion of the carbonate of lime as a cement for the siliceous particles. They vary greatly in hardness and durability, as well as in heaviness; some, as the Reigate stone, weighing 103 lbs. per cubic foot, whilst others found in Scotland, Yorkshire, and the west of England, weigh more than 160 lbs. to the cubic foot. Sandstones are generally more or less *laminated*, that is, the particles appear to have been deposited in layers. These laminations are always parallel to the natural *bed* of the stone, which can be easily detected in most stones of this class; and, as a general rule, sandstones should always be laid in a building upon their natural bed, otherwise they are liable to disintegration. The best stones for building purposes are those which are called *grits*, and are found in Yorkshire, Lancashire, the south of Scotland, Northumberland, and Derbyshire. These are heavy stones, weighing from 140 to 160 lbs. to the cubic foot, and having a resistance to crushing of from 4000 to 8000 lbs. per square inch. The best known of the *grits* in this country are those obtained from the neighbourhoods of Edinburgh, Leeds, Huddersfield, Halifax, Harrogate, Heddon, and Kenton. *Flagstones*, used for paving, sills of

windows, steps, &c., are grits of a highly laminated kind, being easily split into thin slices or flags.

A good building sandstone is obtained from Mansfield in Nottinghamshire, of which there are two qualities, known as the *red* and the *white* Mansfield. It contains a considerable proportion of magnesia, and consequently is not so durable as most of the grits or other sandstones in which that material is absent. The white stone is considered to be a rather better weather stone than the red. Mansfield stone weighs 146 lbs. per cubic foot, and has a resistance to crushing of 5000 lbs. per square inch.

LIMESTONES are largely employed for masonry, but vary greatly in quality, some being very soft and others too hard to be worked. One of the best limestones found in England is the Chilmark stone, which is very durable, and weighs more than 150 lbs. per cubic foot. It has a resistance to crushing of 6000 lbs. per square inch. That obtained from the Isle of Purbeck is also a very useful material for steps, landings, and paving; it weighs 151 lbs. to the cubic foot. The *Rags*, as they are termed, are limestones of a very hard and unworkable character, fit only for common rubble walling; the Kentish-rag is a well-known material belonging to this class. Limestones which are not suitable for masonry are generally valuable for burning into lime, which forms a principal ingredient in mortar.

OOLITES, or *roe-stones*, are limestones of a peculiar structure, being composed of small particles in appearance like the *roe* of a fish. The *Portland* oolite

is highly prized as a building stone, being strong and durable, when obtained tolerably free from fossil remains. That from the Waycroft quarry weighs 136 lbs. to the cubic foot; and its resistance to crushing is about 4000 lbs. per square inch. The *Ancaster* stone is an oolite which also possesses valuable qualities, although inferior in strength and durability to the Portland. Its weight is 140 lbs. per cubic foot, and its resistance to crushing about 2300 lbs. per square inch. The *Bath* stone is of a very soft character, although that which is obtained from the *Box* quarries becomes harder by exposure to the air, and is a serviceable material for external work in localities which are tolerably free from coal smoke. It weighs 123 lbs. per cubic foot, and its resistance to crushing is about 1500 lbs. per square inch. The stone obtained from the other quarries in the neighbourhood of Bath is only fit for internal use.

The stone obtained from the Doulting quarries near Shepton Mallet, Somerset, is a good building oolite, being harder, heavier, and more durable than that from the Bath quarries; it contains a small proportion of silica, which mineral is entirely absent from the Bath stone; and weighs 134 lbs. to the cubic foot. The stone brought from *Caen* in Normandy is largely used in this country for internal masonry, but is too soft to be safely employed for external work; its weight is 125 lbs. per cubic foot, and its resistance to crushing 2000 lbs. per square inch. *Aubigny* stone, imported from the neighbourhood of

Falaise in Normandy, is harder and more durable than that from Caen; its weight is 150 lbs. per cubic foot.

MAGNESIAN-LIMESTONES are not found in such large quantities as the other classes of stone, and are seldom very durable when used externally, especially when exposed to a smoky atmosphere. The hardest and most durable is that from Bolsover, in Derbyshire, the weight of which is 152 lbs. per cubic foot, and its resistance to crushing 8000 lbs. per square inch. The stone from *Anston* in Yorkshire is another of this class, and weighs 144 lbs. per cubic foot. Magnesian-limestones are obtained from other places in Yorkshire, as Roche-abbey, near Bawtry, the stone from which weighs 139 lbs. per cubic foot; also Park-nook, near Doncaster, the stone from which weighs 137 lbs. per cubic foot.

PRESERVATION OF STONE.—Since it is found that some stones are very liable to disintegrate when exposed to the action of weather, or to the acids found in a smoky atmosphere, several methods of checking such destroying influences have been tried, and the most effectual of these appears to be that of giving the stone a coating of a material called the *silicate of lime*. This is done by first washing the surface with a solution of silicate of soda, or flints boiled, until they dissolve, in caustic soda. The surface is afterwards played upon with a solution of the chloride of calcium, or lime dissolved in muriatic acid. By the chemical change which immediately ensues, the silicate of soda becomes silicate of lime, and the chloride of calcium is changed into

common salt, which is easily washed off with water, leaving the face of the stone coated with silicate of lime, which is insoluble in water and is unaffected by weak acids.

The FOUNDATION of a stone wall is formed by laying large flat stones or rough landings extending some considerable distance on each side of the basement wall, and of sufficient thickness to bear, without breaking, the superincumbent weight; these stones are called *footings* or *bottoms*, and are measured and valued separately from the walling, being taken by the superficial foot or yard, describing their thickness.

A RUBBLE-WALL is one that is built of unhewn stone, either with or without mortar. When no mortar is used, as in fences, it is called a *dry-wall*. *Coursed-rubble* walling has the stones gauged and dressed with a hammer, and laid in parallel courses varying in thickness. *Uncoursed-rubble* walling has the stones laid without attention to placing them in courses. This kind of walling is measured either by the superficial yard, describing the thickness, and whether *hammer-dressed* or otherwise finished or *dressed* on the face; or else the walling is taken by the cubic yard, and the work to the face by the superficial yard. Rubble-walling is seldom built less than 18 in. in thickness, and consists of an inner and outer casing, connected together at intervals by *through-stones* which are blocks of stone laid the full thickness of the wall, and tilted slightly towards the outer end to prevent the weather from driving

through; the middle space between the two casings is filled in with broken stones, and grouted with liquid mortar.

The *flints* found in large quantities in the chalk formation are used for building walls, and often cut and dressed so as to form very ornamental features. Walling with flint always requires the mortar to be used *hot*, otherwise it will not adhere to the stone.

Batter is the term applied to walls when the face slopes back from the base towards the top. An extra price is allowed for walls that batter, or the walling may be taken in the ordinary way, and the battered surface measured separately.

Ashlar-facing is stone carefully dressed and laid in courses of equal width to form the outer casing of a wall; it is generally backed up with rubble-walling or brickwork, and the whole tied together by *through-stones* or *bond-stones*; where the backing is of brick, the connection is sometimes made by iron *ties* or *cramps* let into the edges of the ashlar and carried through the wall. In this kind of wall the ashlar is measured separately from the backing; the ashlar is taken by the cubic foot, and the labour on the face and beds by the superficial foot, measuring one plain bed to each stone, and the sawing, if any, to the back. The rubble-backing is measured by the cubic yard; bond-stones by the cubic foot.

Walls built of solid hewn-stone are measured by the cubic foot, and the labour of working the faces and beds taken as above described for ashlar.

Quoin-stones are the blocks of hewn-stone placed

at the outer corners of walls which are built with brickwork or rubble masonry; they are measured in the same way as ashlar, but no deduction is made for them in measuring the rubble-walling.

SAWING is measured by the foot superficial to all concealed parts of hewn-stone which are not left rough.

MOULDED-WORK, as in cornices, string-courses, &c., is girt and taken by the foot superficial. Mouldings to arches or other circular work is taken in the same way, and described as *circular-moulded.*

All the hewn-stone employed in a building is measured by the cubic foot as in the rough before being worked.

JOGGLED-JOINT is a method of fastening the edge of one stone into another by a projecting piece in one edge entering a groove in the other, and answers to ploughing and tongueing in Joinery: this method is generally used in forming balconies or landings of thin slabs of stone, which are made in several pieces. Joggled-jointing is measured by the foot run, or it may be girt and taken as sunk work per foot superficial.

THROATING is cutting a groove on the underside of a projecting sill, to prevent the rain-water from returning and running down the wall; it is taken at per foot run.

SPLAY is where one surface of a stone makes an oblique angle with an adjacent side, and the splayed surface is said to be *sunk* from the original square of the stone; it is taken at per foot superficial.

Chamfer is a small splay which just takes off the edge or *arris* of a stone, and is measured by the foot run.

An Arch is a combination of wedge-shaped stones, or *voussoirs*, built together for the purpose of carrying a wall over an opening whose width is too great to be spanned by a single stone or lintel. The voussoirs of an arch are worked so as to fit accurately, and are laid upon a centering of timber until the mortar is set and the superstructure erected. When the centering is *struck* or taken down, the voussoirs are kept in their places by their mutual pressure, by the weight of the wall above, and by the resistance of the piers or *abutments* on which they stand. The inner line of the face of an arch is called the *intrados*, and the outer line of the voussoirs the *extrados*. The *crown* or topmost stone of an arch is called the *key-stone*, the base is called the *springing*, and the parts between the bases and the crown are called the *haunches*, which are the weakest parts of all arches. In every arch there is, from its very nature, a certain amount of *horizontal-thrust* tending to push over the abutments, which must be built sufficiently strong and heavy to resist it.

In a semicircular-arch having all the voussoirs of equal depth, the weakest joint is that which makes an angle of 30° with the horizon, or at one-third of the distance from the springing to the crown: it is at this point that the horizontal-thrust of the arch has its greatest effect on the abutments; it increases with the size of the arch, being generally propor-

tional to the square of the span. If the height of the abutment from the ground to the springing of the arch is equal to the span of the arch, its thickness ought not to be less than one-fourth of the span; for a greater height of abutment a greater thickness will be necessary. (For investigations on the thrust of arches, see Tarn's 'Science of Building.' *)

In *segmental-arches*, or those which have less than half a circle for their intrados, the springing-joint is called a *skew-back.*

GOTHIC-ARCHES are those which are formed of two segments of a circle meeting in a point at the crown. An *equilateral* Gothic-arch is one in which the *chords* of the two segments are each equal to the span, the radius at the springing being horizontal: in this arch the weakest joint is that which makes an angle of 16° with the horizon, and the horizontal-thrust is greatest at this point. If the abutment equals in height the span of the arch, its thickness must not be less than three-tenths of the span.

GOTHIC-VAULTING is formed by main *ribs* or arches, thrown across from wall to wall of a building, with *diagonal-ribs* springing from the same point and intersecting each other in the middle. The space between the ribs is filled in with light masonry, also arched and springing from the ribs.

Arch stones are measured by the cubic foot according to their original dimensions before being worked; one bed is taken as *sunk* work by the foot superficial; the two ends as circular work, if plain;

* Lockwood & Co.

or circular moulded, if any mouldings are worked upon them.

If stone is hoisted above 30 ft. of height, the *hoisting* is charged extra, according to the number of cubic feet.

Stones above 5 ft. long have their cubical contents measured and described as *scantling lengths.*

FLAGS are thin paving stones from 2 in. to 3 in. thick, and not exceeding a square yard in area; this kind of stone is generally termed 'York,' being mostly obtained from the county of Yorkshire. Paving is measured by the superficial yard, and described as *self-faced flagging*, *quarry-worked* or *boasted*, *tooled* or *rubbed.* If the edges are worked as well, they are measured by the foot run extra.

LANDINGS are flags of larger size than 1 superficial yard, and above 3 inches in thickness. They are measured by the superficial foot, and described as tooled or rubbed. The edges are measured by the foot run, and described as plain or joggled. The sizes of the stones must be described, as the larger landings are more valuable in proportion than the smaller.

CUTTING AND PINNING is letting the ends of stone steps or landings into a wall already built; and is measured by the foot run.

COPING is the name given to the stones laid on the top of a wall to protect it from weather, or for the purpose of receiving an iron balustrade. When the coping is of equal thickness all over, it is termed parallel coping; when thinner at one edge than the

other, it is *feather-edged*; when thinner at the edges than in the middle, it is *saddle-backed.* If the coping projects beyond the face of the wall, the under edge is usually *throated.*

Coping is measured by the foot run, and its form described; unless of extra large size, when it must be measured as other hewn-stone.

Cutting holes for rails in coping are numbered and charged at so much each.

SILLS are the stones laid outside the bottom of windows. When not more than 3 inches thick, they are taken at per foot run, and described as plain, sunk or weathered, throated, &c. Thicker sills are taken as hewn-stone.

Sinks are measured by the superficial foot, their thickness and depth of sinking being described.

CRAMPS are pieces of iron or copper turned down at each end, and used to hold two stones together; they are generally run with lead.

DOWELS are straight pieces of stone or metal let into mortice-holes cut in two abutting stones, for the purpose of preventing them from moving laterally; they are either fixed in cement or run with lead. Cramps, dowels, &c., are numbered, as well as the holes made to receive them.

The LEWIS is a contrivance for temporarily attaching large blocks of stone to the chain by which they are to be hoisted. It consists of two pieces of iron or steel cut in dovetail form, which are let into a hole of similar shape cut in the middle of the stone, and forced into their places by a straight piece of

metal fitting in between them. The three pieces are connected at top by a ring attached to the hoisting chain, and are drawn tight by the strain put upon the chain. Very soft and friable stones of large size cannot generally be hoisted by the Lewis with safety, as the edges of the hole in the stone are liable to break away.

BANKER is the name given to the block of stone or bench upon which the mason works hewn-stone.

BEAM-FILLING is filling with rubble-walling the interstices on the top of a wall between the feet of the rafters, up to the underside of the slates.

ON MEASURING STONE-MASONS' WORK.

There is a variety of opinions respecting the manner of measuring stone-masons' work, both in taking the dimensions for the stone, and also for the labour. It certainly requires more practical knowledge of the operative or working part of the business than any other trade, to determine correctly between these conflicting opinions. The following rules may be considered sufficiently explanatory of the principle on which the practice is governed or founded.

In measuring cube Portland or other stone, all stones that are worked square should be taken accurately as they come from the saw to the banker, of course including the parts laid on or pinned into the walls. But as bevelled or irregularly formed stones cannot be converted without more waste than square

ones, the dimensions should be taken so as to make a fair allowance for such additional waste, particularly as the solid contents of all the different descriptions of Portland stone, whatever shape the stones may be worked to, are abstracted under the same head (viz., cube Portland), and therefore should be of the same value; but which cannot be the case unless the extra waste in the bevelled stone, &c., be allowed for in taking the dimensions. When this is done, it is only requisite, in estimating the prime cost, to calculate for the waste as if all the stones in the building were cut and worked square. If this method were not adopted, it would be requisite, in ascertaining its real value, to make as many different heads in the abstract for cube Portland, as there are different shaped or bevelled stones, accurately describing each, when the calculations for waste, and of course the price, must vary according to each particular form, the trouble of which would be endless, and without any advantage. Indeed, it would come to the same thing, viz., making the necessary allowances for waste, according to the form of the stone. Bevelled or arch stones should be taken about one-sixth above the mean dimension, to allow for waste.

In measuring the cubic contents of spandril steps, some difference of opinion exists as to the best method of taking the requisite dimensions. The following three methods are in common use, viz.:—

1st. Take the length of the step by its extreme width, and by the whole height of the riser measured from tread to tread.

2nd. Take the length of the step by the extreme width from the nosing of the tread to the acute angle, and by half the height of the riser taken from the top of the tread to the acute angle downwards.

3rd. Take the length of the step by its extreme width, and by three-fifths of the depth of the riser taken from the top of the tread to the acute angle downward.

To illustrate these different methods, a diagram is given, Plate 6, fig. 3, showing the method of sawing two spandril steps out of the same block, by which it will be seen that, allowing half an inch only in each step for waste in sawing and taking them out of winding, the original block must not be less than twelve inches deep; and supposing the extreme length of the step, including the part pinned into the wall, to be five feet, the size of the block will be

5	0			
1	3			
1	0			
——		6	3;	

and each step will therefore contain

5	0			
1	3			
0	6			
——		3	1	6

By method 1st, we have

5	0				length of step.
1	3				extreme width.
0	6				whole height of riser.
——		3	1	6	which is correct.

It should, however, be observed, that if the steps, instead of having moulded nosings, were worked plain, the block would only require to be 11 inches deep, as shown by the dotted lines, or one-twelfth less than for moulded steps; whilst the rule gives the same content as before, and consequently it should only be applied for the latter description of step.

By method 2nd, we have

5	0	0			length of step.
1	6	0			extreme width of do. to acute angle.
	4	3			half height of riser from top of tread to acute angle downwards.
		2	7	10	which is about one-twelfth less than the real content.

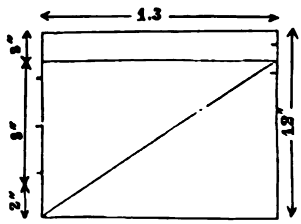
By method 3rd, we have

5	0	0			length of step.
1	3	0			extreme width of do.
	5	8			three-fifths of height of riser from top of tread to acute angle downward.
		2	11	5	which is nearly correct.

A better way than either of the above methods is to take the length of the step by a dimension found as follows, allowing half an inch on each step for waste, thus :—

1 3 width of step.

$6 = \begin{cases} 2 \text{ base of rectangle.} \\ 4 \text{ half do. of triangle.} \end{cases}$



This gives

5 0
1 3
6
—— 3 1 6 as before.

In measuring winders, the content may be found in the same way, taking the extreme length of the step by the mean sectional area, making due allowance for waste.

The labour on the under side to be taken as circular sunk work.

In parts of the country where stone is obtained near at hand, and is therefore comparatively cheap, it is usual to work each spandril step out of the solid rectangular block, the whole of the under portion being cut or hacked off with the chisel, so as to be entirely wasted. The stone must in this case be first measured as cube stone, the same as in solid rectangular or square steps, and the labour to the soffit taken as sunk work.

All stone exceeding three inches thick should be taken as cube measure, with the labour, &c., on ditto.

All stones three inches thick, and under, should be taken as slab, at per foot superficial.

The usual custom has been to measure-in such edges as are worked, and show fair. Objections have been made to this practice, and with some degree of justice; but it will make very little difference, if the edges of thin slabs are measured separately, and a fair price allowed for the labour; and for cutting into narrow pieces for mantles, jambs, &c., it would be nearly equal to the value of the stone: but in thick slabs the same argument will not hold good; and, therefore, as the object in measuring work should be to ascertain its real value, and allow only a fair remunerating price, it appears more correct to measure the labour on the edges at per foot run, offering a fair price, according to their thickness, instead of entering it as stone. An extra price should be allowed for very large scantlings, also for hoisting stones on exceedingly high buildings, according to circumstances.

LABOUR ON PORTLAND OR OTHER STONE.

In measuring the labour of working Portland stone, the principal difference of opinion arises in determining what faces or beds should be taken as plain work. Examples are given, showing the methods of taking the labour on different kinds of common work; but in the measurement of superior work, a plain face must be taken previous to measuring the sunk, moulded, or other work, when the mould could

not be applied without first making that plain face. There cannot be much difference of opinion in taking the other labour, such as sunk-work, moulded-work, circular-sunk, or circular-moulded work, &c., which must be girt as it appears when the work is finished, but which is not always the case with the plain work; and therefore it is requisite to know the manner in which the work is executed, to form an accurate conclusion, and to do justice to the workman in its measurement.

ABBREVIATIONS RECOMMENDED.

In measuring stone-masons' work, the same rules must be observed in entering the dimensions in the book as directed for the other trades; and the following abbreviations are recommended, for the reason stated under that head:—

C P	Cube Portland.	C W	Circular work.
P W	Plain work.	C C W	Circular circular work.
S W	Sunk work.	C S W	Circular sunk work.
M W	Moulded work.	C M W	Circular moulded work.

MEASUREMENT.

STAIRCASES. (Fig. 3, Plate 6.)

ft. in.	ft. in.	
5 0 1 3 0 6	3 1½	Cube Portland steps, the 5 ft. including that part of the step that is pinned into the wall, and also the projection of nosing.
5 0 1 2¼		P W top { 1 1 tread. 0 1¼ under the next riser. 1 2¼ }
4 6 0 7		M W front. Girt of moulding, nosing and riser.
1 3 0 6		M W end. Taken or girt at the average width.

ft.	in.	ft.	in.		
0	6			P W to front the part pinned into the wall.	
0	6				
5	0			P W to soffit.	
1	1				
				[Or the whole flight may be taken in one dimension.]	ft. in.
					0 1¼ } rebate to front of step.
					0 1¾ }
5	0			S W rebate . . .	0 1¾ do. to back of step.
0	4¾				0 4¾
				No. of steps pinned into wall.	
				No. of holes cut for balusters.	
5	0				
1	3	6	3	Block of stone required to cut two steps out of.	
1	0				

LANDINGS. (Plate 6, fig. 1.)

					12 0
					0 6 } in wall.
13	3				0 6 }
4	6			C P landing . . .	0 1½ } joggles.
0	6				0 1½ }
					13 3
2)13	3			P W top and bottom. Here is more plain work than appears, but the plain faces must be made before the joggles are worked.	
4	6				
12	0			M W front.	
0	7				
2) 0	6			P W to front of landing in the walls.	
0	6				
					0 9 girt of the joggle.
2) 4	6			S W joggles . . . (Fig. 2.)	0 4½ do. of the groove for do.
1	1½				1 1½
					13 3
					4 6
22	3			Run of cutting . .	4 6
					22 3
					Cut for and pinning landing into wall, which is allowed to be taken through the doorway, &c., for the extra trouble of pinning up the quoins, &c.

Square steps to Entrance Doors, etc. (Plate 6, fig. 4.)

ft. in.	ft. in.		
2) 6 9 1 1 0 7		C P supposing two steps.	
6 9 1 8		P W to bottom step.	
6 9 1 7½		P W to top step.	
6 9 0 2½		S W rebate for landing.	
6 9 4 1		2 in. Portland landing .	Portland steps worked to an exact length, and fitted between spandrils, allow one end as plain work.
		No. of plugs.	

Coping. (Plate 7, fig. 1.)

3 6 1 9 0 2½		C P feather-edged coping	0 3 0 1½ ——— 0 4½	Nothing extra is allowed for being cut or worked bevel on the face, as it may be done without extra waste.
3 6 2 4½		P W	1 9 top. 0 3 } edges. 0 1½ } 0 1½ } projection over wall. 0 1½ } ——— 2 4½	
1 9 0 2½		P W to Jts. Allow P W to one joint of each stone, which should average 3 ft. in length.		
1 9 0 4½		P W to return of angles where they occur .	0 3 edge. 0 1½ projection. ——— 0 4½	
3 6		Run of throat, or may be taken at . . .	3 6 0 1 M W throat. ———	

Angle quoins may be numbered as extras; or measure the coping through both ways as common coping, which gives an extra length the width of the coping for the extra thickness, and the trouble of sunk work on the top. Or they may be measured thus:—

R

ft. in.	ft. in.		
1 11 1 11 0 3		C P quoin, fig. 2	No. of cramps. Pairs of plugs. Lead for running ditto.
1 11 1 11		S W top.	
*1 11 0 3		P W joint.	
*3 10 0 4½		P W outside edge and projection .	ft. in. 0 3 0 1½ 0 4½
0 4 0 4		S W inside angle notched . .	0 1½ inside edge. 0 1½ projection. 0 1 throat. 0 4

STRING-COURSES. (Plate 7, fig. 6.)

3 6 1 0 0 8		C P string-course.	
3 6 0 2		S W top.	
3 6 0 9½		P W	0 7½ 0 2 projection. 0 9½
3 6 0 1		Throat S W, or run of throat.	
1 0 0 8		P W to one joint of each stone average 3 ft. in length.	

SQUARE PLINTHS WORKED ALL ROUND. (Plate 7, fig. 9.)

2 0 0 11 0 6		C P plinth.	
2 0 2 10		P W sides	0 11 0 6 2)1 5 2 10

* In taking the angle quoins of coping, some will allow the plain top to be taken first; but this is incorrect, as there is no occasion to make it previous to sinking the top; it being only necessary to bring the stone to its thickness and out of winding, as if for plain work.

ft. in.	ft. in.		
0 11		P W top.	
0 6			
1 2		S W rebate.	
0 4			
		No. of mortice holes.	

WINDOW SILLS. (Plate 7, fig. 4.)

4 2		C P window sill.	
0 8			ft. in.
0 6			0 2
			0 6
4 2		P W top, front, and projection . .	0 2
0 10			0 10
0 8		P W to one end.*	
0 6			
			0 6 top.
4 2		S W top and throat . . .	0 1 throat.
0 7			0 7

CURBS. (Plate 7, fig. 5.)

6 0		C P curbs.	
0 7			
0 6			0 6
			0 7
6 0		P W including projection . .	0 6
1 8			0 1
			1 8
0 7		P W to one end of each stone, which should not be less on an average than 3 ft. in length.	
0 6		Take the quoin ends that show fair as P W.	
2 11		C P circular curb. (Plate 7, fig. 7.)	
0 9			
0 6			
2 11		P W.	
0 9			
2) 2 11		C P W.	
0 6			
2) 0 6		S W to arch joints.	
0 6		Plugs per pair, with lead; or allow the lead per lb.	
		Holes, each.	

* This is what is usually allowed. Some claim both ends, others measure them thus:—

2) 0 6		P W to projection of ends.	
0 2			

COLUMNS. (Plate 7, fig. 8.)

	ft.	in.	ft.	in.	
	5	5			C P
	1	5			shaft.
	1	5			
	5	3			C P
	1	3			
	1	3			
	1	11			C P base.
	1	11			
	0	8			
	1	11			C P cap.
	1	11			
	0	8			
2)	5	5			P W
	1	5			shaft taken two sides.
2)	5	3			P W
	1	3			
	5	5			Circular work
	4	6½			shaft.
	5	3			Circular work
	3	11			
	1	7½			S W to bed for joggle in lower stone.
	1	7½			
	1	5			P W top bed of upper stone in shaft.
	1	5			
	1	11			P W top
	1	11			
2)	1	11			P W rims — base.
	0	8			
	6	0			Circular M work
	0	10½			

ft. in.	ft. in.	
1 11		P W top. ⎫
1 11		
2) 1 11		P W sides ⎬ cap.
0 8		
6 0		Circular M work ⎭
0 8½		
		In measuring the circular M work to cap, it should be taken at the average between the angle of abacus and the front.
		If the neck moulding is worked in the shaft, the same dimensions may be taken for C P and labour as the bottom stone of the shaft.

Architraves over Columns. (Plate 7, fig. 10.)

3 0		C P.
1 7		
1 7		
3 0		P W bottom bed.
1 7		
2) 3 0		M W to fronts.
2 0		
1 7		P W to end.
1 7		
1 4		S W to the joggle.
1 0		
1 7		S W to end, including the joggle { ft. in. 1 7, 0 2, 0 2 = 1 11 }
1 11		

Blockings and Cornices. (Plate 7, fig. 3.)

3 6		C P blocking . . . . { 0 8, 0 4; ½) 1 0; 0 6 ½ for bevel. }
1 6		
0 6½		

ft. in.	ft. in.		ft. in.
3 6 3 5¾		P W	1 6 1 7¾ 0 4 ——— 3 5¾
1 6 0 6		P W joint, average size.	
0 9		Run of groove for plugs.	
		No. pairs of plugs, and running with lead, per pair.	
		If the plain work to bed of cornice, on which the blocking stands, is not taken, it would be allowed to take the bottom bed, which would make it 4 ft. 1¾ in. for the P W . .	3 5¾ 0 8 ——— 4 1¾
3 6 2 4 0 8		C P top member of cornice.	
3 0 1 3 0 5		C P bottom member of cornice.	
3 6 2 6		P W beds	1 3 1 3 ——— 2 6
3 0 0 9		P W under blocking.	
3 6 3 0		Sunk and moulded work . . .	1 1 0 10 0 6 0 7 ——— 3 0
1 2		Groove run to joints with lead.	

NICHES. (Plate 7, fig. 11.)

6)1 0 high 1 3 0 9		C P } Stones in body.
12)2 6 1 0 0 9		C P }

ft. in.	ft. in.		
0 9 0 9 0 4		C P head centre stone.	
3) 2 9 1 6 1 3		C P arch-stones taken the whole width, on account of trouble in getting them out.	
3) 2 9 1 6		P W face of do.	
6) 2 9 1 3		S W to arch-joints of do.	
5 0 4 8½		Circular work to body . . .	ft. in. ft. in. 3 × 3 0 = 9 0 $\frac{1}{7}$ = 0 5 ½) 9 5 4 8½
 4 8½		Circular-circular work to spherical head.	
12) 2 6 0 9		P W to bed of stones in body.	
6) 1 3 0 9		Ditto.	
2) 13) 1 0 1 0		S W to arch joints.	
14 8½ 0 7½		S W to front A	5 0 5 0 4 8½ 14 8½
10 0		Run of bead and double quirk.	
4 8½		Circular do.	
		No. of cramps. No. of plugs.	

Stone facings to fronts of houses, if more than three inches thick, should be taken as cube stone,

and the face and one bed and joint taken as P W. Bond stones taken one face bed and joint. If not more than three inches, take them as slab, and one bed and joint as P W. If to circular-headed windows, take the arch joints as sunk work, and the soffits as circular plain work, and the straight reveals as P W. If rusticated, take them as S W. If stone facings are taken to a parallel thickness, as for old brick fronts, they may be taken as slab even to four inches thick, but the P W to beds and joints must not then be taken.

In abstracting masons' work, the paper must be ruled in columns, as before described, observing to place the C P in the first column, and leaving sufficient space in the following columns for the different sorts of labour on ditto, as P W, S W, M W, &c.; the next columns for Portland slabs, keeping each thickness in a separate column; the next columns for vein, statuary, and other marble; the next for Yorkshire and Purbeck pavings, and other articles of different descriptions; the following columns for articles taken as running measure, and the last columns for those numbered.

WEIGHT OF STONE.

Purbeck stone . .	14 cubic feet	weigh	one ton.
Portland . . .	16½ „	„	do.
Bath . . .	18 „	„	do.
Yorkshire . . .	15 „	„	do.
Granite . . .	13½ „	„	do.
Marble . . .	13 „	„	do.
Purbeck paving .	50 ft. superf.	„	do.
Do. step 13 by 6½ .	25 ft. run	„	do.

VALUATION OF LABOUR.

TABLE OF CONSTANTS FOR THE DIFFERENT DESCRIPTIONS OF MASONS' WORK.

N.B.—The factor to be applied is the rate of wages for a mason per day.

		Days.
Labour, squaring and laying new York or Purbeck paving per foot superficial		·021
If in courses, add		·010
Labour on Portland or similar stone per foot superficial. N.B.—Sawing to be taken as half plain work.		
Plain work to bond stones	per foot superf.	·140
Do. to beds and joints	do.	·181
Do. rubbed face	do.	·209
Do. do. circular	do.	·291
Sunk work rubbed	do.	·250
Do. do. circular	do.	·313
Moulded work rubbed	do.	·292
Do. do. circular	do.	·417
Circular work to shafts of columns having the neck moulding or part of the base worked in the same stone	do.	·334
Circular-circular or spherical work to domes or balls	do.	·500
If rubbed, add extra	do.	·049
Taking up, squaring, and relaying old paving	do.	·042
Add if in courses	do.	·015

LABOUR ON STATUARY OR VEIN MARBLE,

INCLUDING SAWING, WORKING, AND POLISHING.

Plain work	per foot. superf.	·875
Circular work	do.	1·250
Sunk work	do.	1·667
Moulded work	do.	2·334
Circular sunk work	do.	2·334
Circular moulded work	do.	3·000

ON OLD WORK.

			Days.
Old vein	marble chimney reset .	per foot superf. .	·125
Do.	do. squared and reset . .	do. . .	·167
Do.	do. sanded, grounded, and squared	do. . .	·209
Do.	do. and reset	do. . .	·250
Do.	do. cleaned and reset . .	do. . .	·250
Do.	do. sanded, polished, and reset	do. . .	·375
Do.	do. sawed, sanded, polished, squared, and reset	do. . .	·626

In the west of England, and all the counties in which stone is abundant, it is usual and customary to build with the rough stone of the country, and the practice generally is to measure the walls by the perch of 18 superficial feet, supposing them 24 inches thick, to which thickness all the walls, whether more or less, are reduced by multiplying the superficial contents by the thickness in inches, and dividing them by 24; or they may be reduced from cubic feet to the perch of 36: but some regulate the prices per perch, according to the thickness of the walls. In other parts the walling is measured by the *rod* of 7 superficial yards.

In measuring the work, some contend that the quoins and all projections should be girt, to pay them, as they say, for the extra trouble in working and setting the stones; but this should not be allowed, except for labour only; and even then it is much fairer to measure the quantity of walling as it is, and make a proper allowance for the extra labour, either in quoins, chimney-breasts, flues, reveals, &c.

ROTATION

To be attended to in bringing the quantities into Bill.

MASON.

Perch. ft. in.			
	Rough stone walling foundations in random courses, well bonded and flushed with mortar, and grouted with hot lime and sand every two courses . .		
	Do. do. above foundations, levelled every two feet or height of two quoins, well bonded and flushed with mortar every course		
	Superficial of extra labour to external quoins		
	Do. do. to internal quoins, &c. .		
	Cube Portland, *or any other stone valued per foot cube* . .		
	Superficial of plain work . .		
	Do. of sunk work, *or such other labour, as the case may be* .		
	Superficial of 1½ Portland slab .		
	Do. 2 do.		
	Do. 2½ do.		
	Do. of 1 in. vein marble slab in chimneys, &c. . . .		
	Do. of 1 in. statuary marble slabs, in do., &c.		
	Do. of Purbeck paving . .		
	Do. of Yorkshire paving, &c.; *then the runs*, as run of Purbeck steps, &c.; *then the Nos.* as number of holes cut, &c. .		

CHAPTER VI.

PLASTERING.

TECHNICAL TERMS AND EXPLANATIONS.

THE business of the PLASTERER consists in covering the inner face of the walls and ceilings of a building with a composition, of which the groundwork is lime, sand, and hair, finished with a coating of finer materials, for the purpose of producing a smoother, less absorbent, and more sightly surface than that of the rough walls. The work of the plasterer also extends to the outside of buildings which have to be *stuccoed* or covered with a coating of cement, and decorated with moulded cornices, string-courses, architraves, and other ornamental features.

Before ceilings or quartered-partitions can be coated with plaster, it is necessary to cover the timbers with *laths* nailed thereon, so as to form a hold or *key* for the plaster. When walls are to be plastered the joints of the brick or stone-work are left quite rough, so that the plaster may have something to hold to. Outside walls in exposed or damp situations are sometimes *battened* with narrow slips of wood fastened to the inside of the walls at

intervals of 12 inches, and to these the laths have to be nailed before the walls can be plastered, as in timber partitions and ceilings.

When large or heavy cornices are to be run round the ceiling of a room, *bracketting* must be fixed by the carpenter before the lathing is nailed to the joists; this consists of pieces of wood fixed at intervals of 12 inches apart all round the portion of the ceiling intended to receive the cornice, and is covered with laths like the rest of the ceiling.

CORNICES and other plaster mouldings are *run* by means of moulds cut in zinc, the exact form of the moulding intended to be used, and fastened to a wooden frame. When a cornice is to receive ornaments, the plasterer leaves sinkings to lay them in. Ornaments are usually cast in plaster-of-paris or papier-maché, from models previously made in clay, and are attached to the cornice or ceiling with plaster-of-paris.

When a very fine surface is required to the walls of a room, it is usual to finish the plaster with MARBLE-CEMENT, which is capable of taking a brilliant polish, and is therefore suitable for internal decorations, as columns, pilasters, architraves, dados, &c. When it is required to paper or paint the walls shortly after they are plastered, PARIAN-CEMENT is employed as a finishing coat, which also produces a very hard and smooth surface.

When ceilings are ornamented with *centre-flowers* or other decorative features, the ornaments are sometimes perforated and connected with a flue passing

between the joists above, to the outside of the building or to a flue running alongside of the chimney flue; by this means the room may be ventilated, fresh air being brought in from the outside, and the impure air drawn off by the draught caused by the chimney. Figs. 44 and 45 show the method adopted

FIG. 44.—VESTIBULE OF THE BATHS, ALHAMBRA.

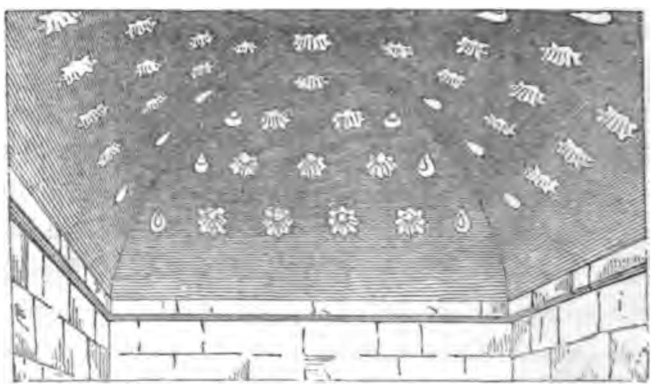
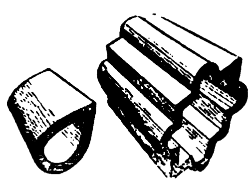


FIG. 45.—EARTHENWARE VENTILATORS OF THE ABOVE.



of ventilating the Moorish baths of the Alhambra by means of pyramidal openings in a domical ceiling.

OUTSIDE-STUCCO to the walls of buildings is usually executed in a material called *Portland-cement*, from its having the appearance, when finished, of Portland-stone. This is gauged with fine sharp sand in various

proportions, but generally about two or three parts sand to one part cement. A coarse coating of stucco is first laid on the wall, purposely left rough to form a key for the next coat; this is finished with fine stuff smoothed over with a trowel. When cornices or string-courses have to be formed, a *core* of Yorkshire stone or plain-tiles is first built into the wall, projecting therefrom a sufficient distance to carry the required mouldings, which are run with a mould in the same manner as other plaster cornices. Where one part of the work has to be finished thicker than the rest, plain-tiles are laid in cement against the wall to give the extra thickness, and the stucco laid over; this is termed *dubbing-out*, and must be measured extra.

PORTLAND-CEMENT is formed by mixing chalk or other limestone with clay, in the proportion of three of the former to one of the latter, in a mill supplied with water, and furnished with revolving harrows to reduce the whole of the particles and secure their complete admixture. After being left for some time to evaporate its superfluous water in large tanks called *backs*, it is dried in stoves, burnt in a kiln, and reduced to fine powder by grinding in a mill. Cement is strongest when used *neat*, or without any admixture of sand, and the greater the quantity of sand mixed with it the weaker it becomes; sand having a good sharp grit should be used for mixing, as very fine sand has a tendency to *kill* the cement. Cement is often used for making floors upon a basis of bricks or concrete; it has the property of *setting*

or becoming hard very quickly, and must therefore only be used in small quantities at a time.

In plain stuccoed work, one bushel of cement, used neat, will cover 10 square feet of work 1 inch in thickness; if gauged with an equal quantity of sand, it will cover twice as much surface; and so on, in proportion to the quantity of sand.

The external angles of chimney-breasts in rooms are frequently formed of cement in preference to wooden angle-staffs.

CLAIRCOLLE is washing over plaster with a solution of *size*, to prepare it for the reception of colour or paperhanging.

WHITENING is washing over plaster, previously claircolled, with a solution of *whiting*.

LIME-WHITING is washing over walls with a solution of *lime*.

All claircolling, whitening, and colouring, is measured by the yard superficial. Old ceilings have to be *washed* or brushed over with water before they can be claircolled; and if there are any cracks, they must be *stopped* with plaster-of-paris after being washed.

External stucco is sometimes executed in BLUE-LIAS LIME gauged with sand; this being an *hydraulic* lime, or one that will set under water, is a valuable material for preventing the rain from penetrating the walls of a building; the proportion of sand to be used is about two or three parts to one part of lime. This material sets more slowly than cement.

PRICKING UP OR RENDERING is the first coat of

coarse stuff, as lime and hair, laid on the walls. If intended to be floated, it is crossed, as a key for the next course or coat; if it is only intended for setting or two-coat work, then it is not crossed, as it is not necessary, and would show through the thin coat of lime and hair.

RENDER SET is two-coat work on walls; viz., one coat of rough plastering performed with lime and hair, and one coat of fine stuff, which is called setting: this is performed by laying on a very thin coat of fine mortar, denominated finishing stuff, which must be well trowelled to prevent its cracking.

RENDER, FLOAT AND SET is three-coat work: one coat of rough plastering crossed; another coat laid on ditto, and floated with a long rule to make it perfectly straight on the face; and one coat of fine stuff or setting on ditto, as 'render set.'

LATH AND PLASTER is lathing on quarter partitions, &c., and one coat of plastering only laid on the laths, as pricking up or rendering is on the walls.

LATH, PLASTER AND SET is two coats on the lathing, as 'render set' is on the walls.

LATH, PLASTER, FLOAT AND SET, is three-coat work on the laths, as 'render, float and set' is on the walls.

TROWELLED STUCCO. This work, either on walls or partitions, is performed as before described for setting; then a thin coat of stucco, which is prepared with a large portion of sand, and laid on similar to the fine coat called setting, in small portions at a time, but worked with water, and trowelled till it is perfectly hard and solid.

Bastard Stucco is executed in a similar way to the above, but the finishing contains a small quantity of hair behind the sand, and it is not hand-floated or trowelled.

All rooms that have plaster cornices must either be floated or have a screed formed all round them, to obtain a straight face for running the cornice by.

Rough-cast is pricked up and floated as if to be set or stuccoed, and then the rough cast (which is composed of half lime and half small stones) thrown with force into ditto; and consequently appears rough on the face when finished.

Depeter is pricked up and floated in a similar manner, and small stones forced on dry from a board, by which the face of wall is finished rough, and the same colour as the stones used.

Depretor is plastering done to represent tooled stone.

Pugging to floors is pricking up between the joists of floors, either on laths or boards, to prevent the sound escaping from one room to another. This should be performed with coarse stuff and chopped hay, if on boards; but if on laths, with lime, sand, and hair; and not less than 1½ in. thick in either case.

Ornaments are said to be worked by hand when they are so designed that they cannot be cast; which renders the work very expensive, as every part must be performed in the plaster as if modelled in clay.

ABBREVIATIONS.

R R	Rough render.	R C B	Rough cast on brick.
R S	Render set.	R C L	Rough cast on lath.
R F S	Render float and set.	If any of these are whitened, add W.	
L O	Lath only.		
L P	Lath and plaster.	W N W	White to new work.
L P S	Lath and plaster set.	W S W	Wash stop and white.
L P F S	Lath, plaster, float and set.	L W 1ce	Lime white once done.
S B	Stucco on brick.	L W 2ce	Lime white twice done.
S L	Stucco on lath.	C C	Common colouring.

ROTATION.

In measuring plasterers' work, first take the ceiling; second, the sides; third, the cornices and enrichments.

MEASURING. (Plate 8.)

Plasterers' work is taken superficially, and valued by the square yard of 9 feet.

If cornices are round the room, take the ceiling only to half the projection of the cornice, or one projection in and one out; or measure the ceilings clear of the cornices, and take the whole of their projection as lathing and pricking up.

If the cornices are bracketed (as fig. 1), measure the ceilings clear of the cornice.

The sides of the room should be taken from the ground, through the bed-mould, or half the height of the cornice.

If on brick, or bracketed (as fig. 1), take them only to the bottom of cornice.

In taking the length of cornices, measure the size of the room, taking one projection in and one out, and girt them from the mould or from the ceiling to the wall line.

Number all the angles in the room above four, as extra.

In taking cornices where there are coves, take the coves as superf. of cove to cornices, and allow 1 inch extra on the girt of the cornice for the return of the mould on the cove.

All enrichments to be taken separately.

Friezes, under the cornice, must be taken as superf. of plain floated frieze. A floated ground must be taken under all enriched friezes.

If cornices are run to old ceilings, a screed must be allowed.

Enriched friezes, ceilings, or soffits must be measured first as plain work, and then the enrichments taken separately at per foot run, and a price fixed according to their description and value.

All circular mouldings and enrichments to be taken one face in and one out, fig. 3.

To explain the foregoing rules, see Section of a Cove Cornice, &c., &c., fig. 2.

Take first the ceiling through the reeds.

Second, length of cove above the cornice by 2 ft.

Third, length of moulded cornice by 1 ft. 2 in., being 1 in. extra for top on cove.

Fourth, do. of plain floated frieze by 6 in.

Fifth, do. of moulded architrave by 6 in.

Sixth, do. of moulded reeds by 9 in.

Reveals to windows taken at per foot run, price according to width.

ABSTRACT.

YARDS.												COLOURING.			SUPERF. FEET.			FEET RUN.	
RR	RS	RFS	LO	LP	LPS	LPFS	FSB	FSL	WSW	WNW	LW	Comm^{s}.	Lemon.	Green	Plain Frieze.	Plain Cornice.	Stucco groins.	Quirks.	B & D Quirk.
												Grey.	Blue.	Red.				Circ. do.	Circ. do.
																		Numbers.	

As some of these articles will not be whitened, as for papering, &c., place them all in the Abstract as not whitened, and the whitening under a separate head, as 'W N W'—white to new work.

ROTATION.

To be attended to in bringing the quantities into Bill.

PLASTERER.

Yds. ft. in.				
	Rough render			
	Render set.			
	Render' float and set . . .			
	Lath and plaster, one coat . .			
	Lath, plaster and set . . .			
	Lath, plaster, float and set. .			
	Stucco on brick			
	Stucco on lath			
	Pugging			
	White new work . . .			
	Wash, stop, and white . .			
	Lime white			
	Colouring, *as the case may be* .			
	Superf. of plain cornice, &c., &c.			
	Then the			
	Run of cornices, girt, &c. . .			
	" reveals			
	" beads, &c.			
	" Nos. of mitres, &c. . .			

VALUATION OF PLASTERERS' WORK.

CALCULATION OF MATERIALS.

1 hundred of lime=25 striked bushels (old measure).

	Materials.	Labour.
100 yards of render set require	1½ hd. of lime. 1 double load of sand. 4 bushels of hair.	Plasterer, labourer, and boy, 3 days each.
130 yards of lath, plaster and set require	1 load of laths. 10,000 nails. 2½ hd. of lime. 1½ dble. loads of sand. 7 bushels of hair.	Plasterer, labourer, and boy, 6 days each.

LATHING.

1 bundle of laths and 384 nails will cover 5 yards.

RENDER ONLY.

187½ yards require . .	1½ hd. of lime. 2 double loads of sand. 5 bushels of hair.

Floating requires more labour than rendering does, but not more than half the quantity of stuff.

SETTING ONLY.

375 yards require . .	1½ hd. of lime. 5 bushels of hair.

20 per cent. is always allowed on the prime cost of the materials.

CALCULATION OF LABOUR.

The decimal is to be multiplied by the rate of wages for plasterer, labourer, and boy, per day.

	Days.
Rough render	·019
Floating do.	·021
Setting	·016
Lathing	·019
If circular work, add to the lathing and also on each coat of plastering	·008
If to groins, add as above	·010

CHAPTER VII.

SMITHS' WORK, IRONMONGERY, BELL-HANGING.

SMITHS' WORK.

THE use of IRON in the construction of buildings of all kinds has become so extensive as to render it one of the most important materials in connection with building operations, both for structural and ornamental purposes.

CAST-IRON is obtained by pouring the molten metal into sand moulds prepared from wooden models the exact size (with a certain allowance for contraction in cooling) of the required article. It is brittle and is readily fractured by a heavy blow, presenting a crystalline appearance when broken. Cast-iron is of great value for sustaining heavy compressing loads, as in pillars or other supports; its resistance to *crushing* being from 30 to 50 tons per square inch. Its resistance to a *stretching* force is only one-sixth of the resistance to compression, consequently it is not so suitable for forming into beams as in using for pillars. When a large number of beams of the same size are required, great economy is obtained by using cast-iron; in which case the ⊥ form of section is

employed, the lower *flange* being made to contain nearly six times as much iron as the upper, since that part has to resist a stretching force, and is made proportionately large in order to counteract the deficiency in the resisting power of the metal to an extending force.

The breaking-weight laid on the centre of a cast-iron beam of this form is found, in tons, by multiplying the area of the section of the bottom flange at the middle, in inches, by twenty-six times the depth of the beam in inches, and dividing the product by the length of the bearing or span between the supports, also in inches. The permanent load on a cast-iron beam should not be more than one-sixth of its breaking-weight. In order that a beam whose lower flange has the same width throughout, may be of uniform strength in every part, the height should vary so as to form an ellipse, having its greatest height in the centre. If the beam is of equal height throughout, the lower flange should be in the form of two segments of circles, having the greatest breadth in the middle. If the load on a beam is uniformly distributed over its entire length, it will bear twice as much as when all the load is in the middle.

The mode of finding the strength of cast-iron columns depends upon the relation which exists between their length and diameter. When the length is thirty times the diameter, or more, the column will break by bending only, the resistance to crushing not coming into play. If we call W the breaking-weight in tons, D the external diameter in inches, *d*

the internal diameter for a hollow column, l the length in feet; we find the breaking-weight from the formula,

$$W = 42 \frac{D^{3.5} - d^{3.5}}{l^{1.63}}$$

The following table of values of $D^{3.5}$ and $l^{1.63}$ will facilitate the application of this formula:—

$2^{3.5} = 11.3$	$5^{1.63} = 13.8$
$2.5^{3.5} = 24.7$	$8^{1.63} = 29.6$
$3^{3.5} = 46.8$	$10^{1.63} = 42.7$
$4^{3.5} = 128$	$12^{1.63} = 57.4$
$5^{3.5} = 279$	$15^{1.63} = 82.6$
$6^{3.5} = 529$	$20^{1.63} = 132$

The breaking-weight of a solid column can be found by the same formula, by merely putting $d = 0$.

When a very inferior quality of iron is employed, the above formula will give too great a value for the breaking-weight; and the multiplier in that case should be 34 instead of 42: for very superior qualities the multiplier will be as high as 50.

This mode of calculating does not answer for shorter columns, in which the length is between ten times and thirty times the diameter, since the resistance to crushing then comes into play. To find the breaking-weight of such a column, first apply the foregoing formula, and obtain the breaking-weight as if it were a long column; multiply that result by forty-nine times the area of the section of the column in inches, and divide the product by the first found breaking-weight added to thirty-six times the area of the section. For columns under ten times their diameter in length, we have only to take into consideration the resistance to crushing, or to multiply the

area of section by 49 tons for hollow columns, and by 39 tons for solid columns. Greater strength in proportion to weight of metal is obtained in using hollow columns than solid, as the inner metal is softer and weaker in solid columns than that near the outside; and the thinner the metal the greater its comparative resistance to crushing. The permanent load upon cast-iron pillars should not exceed one-fourth their breaking-weight.

Cast-iron should never be employed where it is liable to be subjected to sudden blows or jars, or to great variations of temperature; and if water comes in contact with it when hot, it will fly into pieces.

Another and simpler method of finding the breaking-weight of a solid cast-iron column, and which will give sufficiently accurate results for any length as compared with the diameter, is as follows: take the *ratio* or proportion which the *length* bears to the *diameter* (as 5 times, 10 times, 20 times, and so on), and add 330 to the *square* of that *ratio*; then divide 270,000 by the sum, and the result is the breaking-weight in cwts. per square inch of section. The safe permanent load may be one-fifth to one-seventh of the breaking-weight obtained by this rule. The weight is supposed to act vertically down the axis of the column, whose ends are perfectly flat and parallel. If the column is hollow, the strength depends upon the thickness of the metal; when the metal is $\frac{1}{10}$th of the diameter in thickness, first multiply the *ratio* by $\frac{3}{4}$ before applying the above rule; if the thickness is $\frac{1}{7}$th of the diameter, the *ratio* must be multiplied by $\frac{4}{5}$;

if $\frac{1}{5}$th of the diameter, the *ratio* is to be multiplied by $\frac{7}{8}$ if $\frac{1}{4}$th, it must be multiplied by $\frac{9}{10}$. The strength pe square inch of a square column is to that of a round one as 8 to 7; so that the *ratio* being multiplied by $\frac{7}{8}$, the above rule will apply to solid square pillars.

Story-posts are iron pillars, generally cast of an I section, and used to support the ends of bressummers over the openings for shop-fronts. The strength of cast-iron story-posts may be found by the rule above given for round pillars, only the *ratio of length to diameter* must be first multiplied by $1\frac{1}{5}$ for thickness of metal equal to $\frac{1}{10}$th the diameter; by $1\frac{1}{6}$ for metal of thickness $\frac{1}{7}$th the diameter; by $1\frac{1}{7}$ for thickness equal to $\frac{1}{5}$th the diameter; and by $1\frac{1}{8}$ for thickness equal to $\frac{1}{4}$th the diameter.

Cast-iron in girders, story-posts, columns, and all other heavy articles, is charged by the ton or cwt. When models have to be made expressly for iron-castings, they are charged extra according to the labour in them. The weight of a cubic foot of cast-iron is 444 lbs.; so that the weight of one foot length of a solid round column of given diameter can be found by means of Table V. (page 94). The *area* expressed in parts of a foot multiplied by 444 gives the weight of 1 foot length. If the area is in square inches, multiply by 3·1 to obtain the weight in lbs. of 1 foot length. To find the weight of a *hollow* column, first find that of a solid one of the same external diameter, and also that of a solid one of the diameter of the hollow part; deduct the latter from the former, and the result is the weight of the hollow column.

The weight of a superficial foot of cast-iron 1 inch in thickness is 37 lbs.; that of a solid circular rod 1 inch in diameter and 12 inches long, is 2·44 lbs., or a little under 2½ lbs.; and since the weight increases as the square of the diameter, the weight of a rod 12 inches long of any other diameter can be found by multiplying the square of its diameter by 2·44, or, nearly, by 2½. The weight of a solid rod of cast-iron 1 inch square and 12 inches long, is 3·1 lbs.; and that of any other square rod of the same length may be found by multiplying the square of one side by 3·1.

The following Table of the weight in lbs. of one foot of cast-iron cylinders, of different diameters, will greatly facilitate the calculation of the weight and value of columns:—

Diameter of bore, in inches.	Thickness of metal, in inches.						
	¼	⅜	½	⅝	¾	⅞	1
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	2·7	4·7	7·3	9·9	12·8	16·0	19·6
1½	4·3	6·9	9·8	13·0	16·6	20·4	24·5
2	5·5	8·7	12·3	16·1	20·3	24·7	29·4
2½	6·8	10·6	14·7	19·2	23·9	29·0	34·4
3	8·0	12·4	17·2	22·2	27·6	33·3	39·3
3½	9·2	14·3	19·6	25·3	31·3	37·6	44·2
4	10·4	16·1	22·1	28·4	35·0	41·9	49·1
4½	11·7	17·9	24·5	31·4	38·7	46·2	54·0
5	12·9	19·8	27·0	34·5	42·3	50·5	58·9
5½	14·1	21·6	29·5	37·6	46·0	54·8	63·8
6	15·2	23·5	31·9	40·7	49·7	59·1	68·7
6½		25·3	34·4	43·7	53·4	63·4	73·4
7		27·2	36·8	46·8	56·8	67·7	78·5
7½		29·0	39·0	49·9	60·7	72·0	83·5
8		30·8	41·7	52·9	64·4	76·2	88·4
8½		32·9	44·4	56·2	68·3	80·8	93·5
9		34·5	46·6	59·1	71·8	84·8	98·2
9½			49·1	62·1	75·5	89·1	103·1
10			51·5	65·2	79·2	93·4	108·0
10½			54·0	68·2	82·8	97·7	112·9
11			56·4	71·3	86·5	102·0	117·8
11½			58·9	74·3	90·1	106·3	122·7
12			61·3	77·4	93·6	110·6	127·6

RAIN-WATER-PIPES, or *fall-pipes*, are made of cast-iron in 6-feet lengths, fitting one into another with a socket-joint, and used for conveying the rain-water from the gutters to the drains; when several lengths are fitted together to form one continuous pipe, it is termed a *stack*. They are sold by the yard run, according to their diameter. These pipes are fastened to the wall with large spike-nails driven through *ears* cast upon the upper end of each length of pipe; the nails being sold by number. The *Heads* of rain-water-pipes are separate castings, the upper part being much wider than the pipe, to receive the water direct from the gutter; they are numbered in the bill. *Shoes* are short lengths of pipe bent at an angle, and fitted to the lower end of the stack, for the purpose of shooting the water away from the wall, or into the drain. They are numbered in the smith's bill.

Elbows, or *bends*, are short lengths of pipe cast with a particular curve, to carry a pipe over a moulded string-course or other projection, or to divert the direction of the pipe. They are numbered and valued separately from the pipes.

EAVES-GUTTERS are cast-iron channels fixed at the eaves of a roof to receive the rain-water and convey it to the fall-pipes. They are cast in 3 ft. and 6 ft. lengths, and fitted together by sockets cast on one end of each length; they are sold by the yard, according to their size and shape. *Nozzles* are short pieces of pipe hanging down from the gutter and cast in one piece with it, to convey the water into the fall-pipe head. They are charged separately and num-

bered. *Elbows* are pieces of guttering cast with a bend or angle to carry the gutter round an angle of a wall. They are numbered separately. Eaves-gutters are fastened by *brackets*, every three-feet length, driven into the wall, or screwed to the feet of the rafters. Brackets are numbered; also all *stopped-ends* to gutters are numbered. Bolts, nuts, and screws for fastening the lengths of guttering together, are charged by the dozen. *Clips* are numbered at *each.*

Cast-iron railings, gates, gratings, casements, brackets, cantalivres, &c., are charged by the pound, according to the nature of the work. When lead is used for running the iron into stone-work, it is charged separately by the pound weight.

Air-bricks of cast-iron, or small gratings the size of one or more bricks, for ventilation through a wall, are numbered. *Coal-plates* with hooks are numbered. *Door-scrapers* of cast or wrought iron are numbered.

WROUGHT-IRON is a metal which has been reduced to a fibrous condition, and rendered capable of being hammered or wrought into various shapes. It is softer than cast-iron, and its power of resisting a crushing force is one-third that of the cast metal. For very long solid columns, whose length exceeds thirty diameters, it is, however, considerably stronger than cast-iron, since its resistance to bending is three times as great. It is not, however, often employed for columns, on account of the much greater cost of manufacture. The resistance of wrought-iron to crushing is about 16 tons per square inch of

section, the resistance to stretching being 24 tons per square inch.

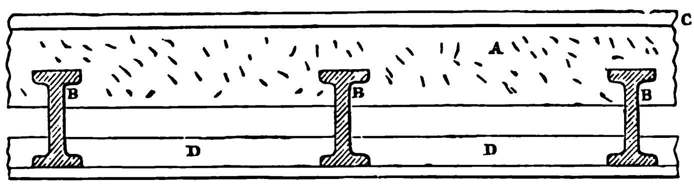
The following simple rule enables us to find with considerable accuracy the strength per square inch of section of a wrought-iron pillar of circular section: take the *ratio of the length to the diameter*, square it, and add it to 2000; then divide 680,000 by the sum, and the result is the breaking-weight per *square inch of section* in cwts.; and multiplying by the number of square inches in the section gives the strength for the particular pillar. The ends are supposed to be perfectly flat and parallel, and the load acting down the axis. The safe weight may be $\frac{1}{4}$th or $\frac{1}{5}$th of the breaking-weight. If the column is square, it will bear a greater load per square inch than if round; and the above *ratio* must be multiplied by $\frac{7}{8}$ before the rule can be applied to square pillars. Pillars having L, T, or + sections are weaker in proportion than round pillars having the same area of section; and the *ratio* must be multiplied by $1\frac{1}{5}$ where the metal is $\frac{1}{10}$th of the diameter in thickness; by $1\frac{1}{6}$ if it is $\frac{1}{7}$th of the diameter; by $1\frac{1}{7}$ if it is $\frac{1}{5}$th of the diameter; and by $1\frac{1}{8}$ if it is $\frac{1}{4}$th of the diameter.

Wrought-iron is largely used in construction for forming joists, girders, roofs, bridges, &c.

Joists are rolled into a great variety of shapes and sizes, those most commonly used having the I or T form of section. A very good FIREPROOF-FLOOR can be made with such joists (B, fig. 46), placed about two feet apart, and filled in between with 4 inches or so of

cement concrete (A), laid upon temporary boarding below, and completely covering the top of the joists.

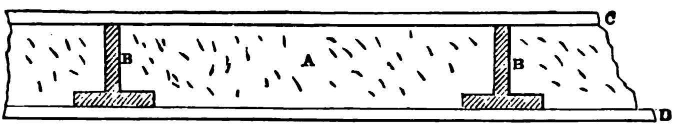
FIG. 46.



The floor may be finished in cement (C), or light joists and floor boards laid on the concrete, and the ceiling-laths nailed to light ceiling-joists (D), laid between the lower flanges. Such a floor is thoroughly impervious to sound as well as to fire, but can only be used in buildings of a substantial character, as the weight of the floor upon the walls is very considerable.

A cheaper and lighter kind of fireproof floor may be constructed on a similar principle to the last, but with inverted tee-iron joists, as shown in fig. 47.

FIG. 47.



The depth of the joists (B) will depend upon the bearing; the concrete (A), which should be made with Portland-cement, rests upon the flanges of the joists, and forms a solid mass between the floor (C) and the ceiling (D). The ceiling can be plastered against the underside of the concrete, thereby saving

the cost of laths and ceiling-joists. The floor may be of cement or wood, as before mentioned. If the bearing is more than 12 feet, it will be better to use iron binders 8 or 10 feet apart, and rest the ends of the joists upon them. The load in tons that may be laid on the centre of a T joist, so as to produce a strain of 5 tons per square inch, is found as follows: the area of the vertical web multiplied by half the depth of the beam, multiplied by 20 and divided by the span; all dimensions being in inches. Double this load can be borne, if equally distributed over the whole length.

LARGE BEAMS of wrought-iron are formed by rivetting together by means of L iron thin plates of metal into the form of I, and called *plate-girders*; or in the shape of a long rectangular box, and called *box-girders*. The breaking-weight in tons in the middle of such beams can be approximately found by multiplying the area in inches of the bottom flange by the depth of the beam in inches, and dividing by the length of bearing in feet, the result being multiplied by 6 for plate-girders of the I form, by 6·5 for box-girders, and by 7 for rolled joists. The area of the top flange should be half as much again as that of the lower flange. Wrought-iron beams may be permanently loaded with one-third or one-fourth of their breaking-weight. When the weight is equally distributed over the entire length of a beam, it will bear twice as much load as when all is placed at the centre.

Wrought-iron is extensively employed in the construction of roofs. The parts of a roof which are

subject to stretching only, as the tie-rods, king or queen rods, or other suspenders, are made of round or flat bar-iron. Those which have to sustain a longitudinal and transverse strain combined are made of angle or tee-iron. The main rafters of roofs of large span are generally plate-beams, formed in the I shape by rivetting three plates of iron together. Cast-iron struts are sometimes introduced where resistance to compression is required. The price for iron roofing is charged by the number of squares of 100 superficial feet covered, and increases with the span.

CORRUGATED-IRON is thin sheet-iron rolled into a wave form, which gives it great strength to resist bending. It is used largely for the covering of iron roofs, and is then *galvanised*, or coated with a thin layer of zinc, to preserve it from decay. Curved roofs for sheds are made very cheaply in this material, without any framework except tie-rods and suspension-rods.

Iron *tanks* and cisterns for water are formed of sheets rivetted with angle-iron at the corners, or by turning in the edges at a right angle and rivetting them together; and are prevented from bulging by tie-rods placed across at one-third of their depth from the bottom. The iron is galvanised to protect the tanks from decay. They are valued according to their cubical contents, and charged at a price per gallon.

The weight of one cubic foot of wrought-iron is 480 lbs.; that of a superficial foot 1 inch thick, is 40 lbs.; that of a superficial foot one-eighth of an inch thick, is 5 lbs.; that of a rod 1 inch square and 12

inches long, is $3\frac{1}{3}$ lbs.; and the weight of a square rod of the same length and any other size is found by multiplying the square of one side (in inches) by $3\frac{1}{3}$. The weight of a round rod of wrought-iron 1 inch in diameter and 12 inches long, is $2\frac{2}{3}$ lbs., and the weight of a round rod of the same length and any other diameter, is found by multiplying the square of the diameter (in inches) by $2\frac{2}{3}$ lbs.

Heavy articles in wrought-iron, as girders, joists, &c., are charged by the ton or cwt.

Galvanising is always charged extra at per foot superficial of surface covered.

Wrought-iron in straps, bolts, plates, screw-bolts, nuts, and washers, above 1 inch in diameter, are sold by the pound.

CHIMNEY-BARS are wrought-iron flat bars passed through the chimney jambs and under the arch that spans the opening for the fireplace; the two ends are turned up and down outside the wall of the chimney. They are charged by the pound.

Cores for handrails are narrow bars of iron let into the underside of the handrail of a staircase to receive the ends of the iron balusters. They are valued by the pound, and described as straight or wreathed.

Wrought-iron railings, gates, handrails, balusters, brackets, &c., are charged by the pound, unless highly ornamented, when they are charged according to the labour.

SADDLE-BARS are small wrought-iron bars let at each end into the stone jambs of a window, to which the lead lights are tied with copper. They are

charged by the pound. *Casements* of wrought-iron are charged by the pound, or numbered and described.

Rivets for fastening plates of iron together are sold by the cwt.

The following is the weight of rolled ANGLE-IRON per foot run, having equal sides:—

Angle-iron with	1½ in. sides,	¼ in. thick,	weighs	2½ lbs.	per foot.
Do.	1¾ „	¼ „	„	3	„
Do.	2 „	¼ „	„	3¾	„
Do.	2¼ „	$\frac{5}{16}$ „	„	4½	„
Do.	2½ „	⅜ „	„	5¾	„
Do.	2¾ „	⅜ „	„	7	„
Do.	3 „	⅜ „	„	8	„

The following is the weight of rolled TEE-IRON per foot run, of equal depth and width:—

Tee-iron with	1 in. sides,	$\frac{3}{16}$ in. thick,	weighs	1 lb.	per foot.
Do.	1¼ „	¼ „	„	1¾	„
Do.	1½ „	¼ „	„	2¼	„
Do.	1¾ „	¼ „	„	3	„
Do.	2 „	$\frac{5}{16}$ „	„	3¾	„
Do.	2¼ „	$\frac{5}{16}$ „	„	4½	„
Do.	2½ „	$\frac{5}{16}$ „	„	5	„
Do.	3 „	⅜ „	„	7½	„
Do.	3½ „	⅜ „	„	8½	„
Do.	4 „	⅜ „	„	9¾	„
Do.	5 „	$\frac{7}{16}$ „	„	13¾	„
Do.	6 „	½ „	„	19¼	„

The following is the weight of rolled IRON JOISTS, of **I** form, like railway bars, per foot run:—

I-bars,	4½ in. deep,	2½ wide,	⅝ thick in middle,	weigh	21⅝ lbs. per ft.
Do.	4½ „	2½ „	¾ „	„	23⅓ „
Do.	5 „	2⅝ „	¾ „	„	25 „

The following is the weight of hammered FLAT BAR-IRON, per foot run:—

Flat Bar-iron,	1 in. wide,	$\frac{1}{8}$ in. thick,	weighs	$\frac{2}{5}$ lb. per foot.		
Do.	$1\frac{1}{2}$	,, $\frac{1}{8}$	,,	,,	$\frac{2}{3}$	,,
Do.	2	,, $\frac{1}{4}$	,,	,,	$1\frac{2}{3}$	,,
Do.	$2\frac{1}{2}$	,, $\frac{1}{4}$	,,	,,	$2\frac{1}{10}$	,,
Do.	$2\frac{1}{2}$	,, $\frac{5}{8}$	,,	,,	$5\frac{1}{4}$	,,
Do.	3	,, $\frac{1}{4}$	,,	,,	$2\frac{1}{2}$	,,
Do.	3	,, $\frac{5}{8}$	,,	,,	$6\frac{1}{3}$	,,
Do.	$3\frac{1}{2}$	,, $\frac{1}{4}$	,,	,,	3	,,
Do.	$3\frac{1}{2}$	,, $\frac{5}{8}$	,,	,,	$7\frac{1}{3}$	,,
Do.	4	,, $\frac{1}{4}$	,,	,,	$3\frac{1}{3}$	,,
Do.	4	,, $\frac{5}{8}$	,,	,,	$8\frac{2}{5}$	,,

The following is the weight of ROUND BAR-IRON, per foot run:—

Round Bar-iron,	$\frac{1}{2}$ in. diameter,		weighs	$\frac{2}{3}$ of a lb. per foot.	
Do.	$\frac{3}{4}$	,,	,,	$1\frac{1}{2}$	,,
Do.	1	,,	,,	$2\frac{2}{3}$	,,
Do.	$1\frac{1}{4}$	,,	,,	$4\frac{1}{8}$	,,
Do.	$1\frac{1}{2}$	,,	,,	6	,,
Do.	$1\frac{3}{4}$	,,	,,	8	,,
Do.	2	,,	,,	$10\frac{1}{2}$	,,

The following is the weight of SHEET-IRON, per superficial foot:—

Sheet-iron	·022	in. thick,	weighs	1 lb.	per foot.
Do.	·032	,,	,,	$1\frac{1}{3}$	,,
Do.	·042	,,	,,	$1\frac{2}{3}$	,,
Do.	·056	,,	,,	$2\frac{1}{5}$	,,
Do.	·065	,,	,,	$2\frac{1}{2}$	,,
Do.	·083	,,	,,	$3\frac{1}{5}$	,,
Do.	·095	,,	,,	$3\frac{3}{4}$	,,
Do.	·125	,,	,,	5	,,
Do.	·137	,,	,,	$5\frac{1}{2}$	,,
Do.	·158	,,	,,	$6\frac{1}{3}$	,,
Do.	·187	,,	,,	$7\frac{1}{2}$	,,

STABLE FITTINGS being now almost universally made of iron, should be placed, both in the Specification and in the Bill of Quantities, under the Smiths' work. Both cast and wrought iron are employed in the various fittings of stables, but the use of cast-iron must be avoided in those parts which are exposed to the kick of a horse, as any breakage will not only be injurious to the fittings themselves, but may also endanger the safety of the animal.

Stables for horses are usually divided into *stalls* about 6 feet wide, by means of parallel divisions 9 feet in length. The stall divisions are formed with a strong iron *post* at the outer end, let firmly into the ground; an iron *cill* is laid on the ground from the foot of the post to the wall forming the head of the stall; an iron *ramp-rail* is let into the head of the post at one end, the other end being firmly fixed into the wall. The post, rail, and cill have each a groove formed in them to receive the wooden matched-boarding with which the division is filled in from head to cill. This is generally 2 inches in thickness, and well tongued. The height of the division should be about 4 ft. 6 in. at the lower end, and 6 ft. 6 in. at the wall end. Instead of solid boarding the whole height of the division, a horizontal rail is sometimes fixed about 4 ft. 6 in. above the cill, and the boarding filled in between it and the cill. Above this rail is placed the ramp-rail, and the space between the two rails filled in with open iron-work, either of a plain or ornate character. By this means better ventilation is obtained than by the method of close boarding. All

sharp arrises must be avoided in the open iron-work, which should be of wrought-iron, so as to avoid danger to the horses from fracture. Strong rings of iron or brass are usually attached to the top of the post, for securing the horse when occasion requires.

The food for the horse is placed in a set of fittings fixed against the wall at the head of the stall, about 3 ft. from the ground. This consists of a rack for hay, a manger for corn, and a trough for water, having a ring for securing the animal attached to the front edge.

Thorough drainage of a stall is effected by laying the paving bricks with a fall each way towards the middle of the stall, in which is placed a trough gutter of iron, covered over with a movable iron plate fitting into the rebated edges of the guttering, and laid flush with the paving. The water passes through perforations in the cover, and away into the drains. Iron gratings, with traps to prevent the smell from rising, are placed over the junction of the guttering with the drain.

A loose-box is a space cut out of the stable equal to about two ordinary stalls in area, so that a horse can move freely about therein. The height of the division is greater than that of the stalls, and uniform all round. There is an iron cill and horizontal rail, the space between which is filled in with 2-inch boarding about 5 ft. 6 in. high. Above this is open iron-work, with a top horizontal rail 2 ft. more in height. The whole is completely enclosed on all sides, having a door of the same construction as the

divisions. The rack, manger, and water-trough are placed in one corner of the loose-box, and the space below them must be enclosed either with round wrought-iron bars or with wood framing, to prevent the horse from injuring itself by getting under the fittings. The drainage of a loose-box is effected by laying the paving with a slope each way towards the centre, in which a trapped *horse-pot* is fixed to receive the urine and convey it to the drain.

There are various other fittings connected with the stable, harness-room, and coach-house, which are made of iron; as the wrought-iron corn-bin, by which the food is effectually protected from vermin; iron rings for head-stall chains; iron ventilating-valves for placing over the head of the stall. For the harness-room a close pedestal stove is provided, with boiler for supplying hot water for the purposes of the stable; also a saddle and harness horse, under which hot-water pipes from the boiler may be laid for drying the harness and saddles when wet; ceiling-hooks with slides, for the purpose of cleaning harness upon; open iron ventilating brackets, for hanging the harness, saddles, &c. upon, being made to the shape of the harness, and a free passage of air provided between the several parts, for the purpose of drying them underneath. These are either japanned, galvanised, or covered with leather or gutta percha.

In bringing stable-fittings into bill, each separate item must be described, the stall-posts taken at each, according to size, the rails by the foot run, the

guttering at the foot run, tee-pieces, angles and traps being taken separately at each. The mangers, racks, and water-troughs are taken at each and described as cast or wrought iron, plain or enamelled. Harness fittings, stoves, brackets, &c., are charged each, or in sets, and described as japanned, galvanised, covered with gutta-percha, or covered with leather.

Iron is extensively used as the material for the fittings of COW-HOUSES, which are divided into double stalls 7 or 8 ft. wide by division plates of cast-iron, the front having a round dwarf post. Each cow is fastened by a chain passing round the neck, the end of which slides up and down a vertical rod attached to the stall-division. The feeding and water troughs are of cast-iron, and raised a little above the pavement. The fodder is placed in a wrought-iron rack, which is fixed about a foot above the trough. Behind the troughs and rack there is a passage by which the food can be brought to them without disturbing the animals.

PIGGERIES are also constructed with cast-iron divisions and troughs, which may be provided with swing shutters, so that the troughs may be filled on the outside, and the shutter being moved backwards enables the animal to get at the food.

The fittings for cow-houses and piggeries are charged in the Bill according to the number of animals to be accommodated.

CIRCULAR-IRON-STAIRCASES are spiral stairs connected together by a central newel-post. They are charged at per step, according to the diameter of the staircase.

Balconies and *tomb-railings*, of common pattern, are charged at per foot run, according to the height and character of the design.

Hoop-iron, used as bond for brickwork, is charged at per cwt., according to quality.

Ties and *straps* to roofs and floors are charged at per pound; the nuts and screws to same are charged separately at per pound, but at a higher price.

Tanks of large size, made of wrought-iron plates not less than $\frac{1}{8}$ inch thick, are charged at per cwt., and described as galvanised or otherwise.

STOVES for the open fireplaces of rooms vary greatly in character and cost. *Elliptic stoves* consist only of a pair of *hobs*, with bars in front of an elliptic form. They are charged according to the width of the opening, at per inch, the price varying with the quality. *Sham-fronts* are, as their name implies, only made with a front to fit into the opening, and a grate for the fire without hobs. They are sold at per inch in width. *Register-stoves* are entirely enclosed from the chimney, with which they communicate by a *valve* or *register*, which can be opened or closed at pleasure. They are generally made without hobs, and with or without fire-brick *backs* and *cheeks*. They are generally sold at per inch, according to width of opening, the price varying greatly, according to the thickness of metal, the ornamentation, and general finish.

COOKING-RANGES are made either open or enclosed; when enclosed they are termed *kitcheners*, and are provided with an iron cover to enclose them from the chimney, with a register therein to regulate the

draught. The top of a kitchener forms one continuous hot plate, and the smoke is carried away by a pipe or flue at the back. The price varies greatly, according to quality, but is generally proportioned to the width of the opening. *Open-ranges* have the fire quite open, an oven being on one side, and a boiler on the other: the better kind are made to wind-up, so that the width of fire may be regulated as required. The price is charged at per inch of width, but varies greatly, according to quality. In common ranges the boiler is of cast-iron, and in the better sort it is of wrought-iron. The boiler of a range is kept constantly full by a feed-pipe from a small cistern set on the same level outside the fireplace, in which the water is kept always at the level required in the boiler by means of a ball-cock.

Coppers are charged at per lb., when made of copper. They are frequently made of cast-iron, and called *set pots*. These are sold by the cwt. The bearing-bars, furnace-doors, grates, &c., for coppers are charged separately; the bars by the lb., and the doors and grates at a price for each.

The Setting of stoves, ranges, and coppers is charged in the bricklayer's account according to number.

IRONMONGERY.

Under this title are included nails, screws, bolts, pulleys, hinges, door-springs, casement and sash fastenings, locks, latches, shutter-bars, lifts, rings, knobs, buttons, brackets, hooks, hat-pins, and all other arti-

cles of iron or brass fixed by the joiner. Ironmongery is generally placed in the Bill of Quantities, immediately after the Joiners' Bill; and the articles are all numbered either at each or at per pair.

Twenty per cent. profit is allowed on the prime cost of all ironmongery.

NAILS in large quantities are sold by weight, and are charged in the Bill at per hundred or per thousand, under the names of tacks, cut-brads, flooring-brads, cut-clasp, and wrought nails, which are sold as threepenny, fourpenny, sixpenny, &c., according to the price per hundred. Brass-headed nails and screws, either of iron or brass, are charged at per dozen. BOLTS are made of iron or brass. Iron bolts for doors are of various kinds, bright-barrel, rough-rod, bright-rod, and spring-plate. They are charged at *each*, the length being described. Brass flush-bolts are iron bolts with brass face-plates, and are let into a groove cut in the door, so as to have the face-plate *flush* or even with the surface of the door. They are charged each, the diameter of the iron bolt and the length of the face-plate being described. Espagnolette bolts are long bolts going the whole height of a French casement, and having a fastening at top and bottom, and also in the middle. They are charged according to their length at per foot.

HINGES for hanging doors, casements, flaps, &c., are of great variety, and generally charged at per *pair*. *Butt* hinges have the knuckle projecting from the face of the door, and are screwed to the edge of the door and to the rebate of the jamb; so that when

the door is closed the two parts or flaps of the hinge come close together. *Back-flap* hinges are used for shutters hung in several folds or flaps. They are similar to butts, but have a longer flap, which is screwed to the back of the shutter. Butts and back-flaps are described by their height, and sold at per pair. *Cross-garnet*, or tee-hinges, are made of a T form, and are valued according to the length measured from the joint.

SPRING-HINGES are made to cause a door to fall-to of its own accord. They are of great variety of construction and cost. The better sort consist of a box containing the spring, let into the floor at the bottom of the door, and are sold either singly or by the pair.

GATE-HINGES, for gates and coach-house doors, are made with a long arm bolted to the face of the door, and turn on a pivot fixed to the post or jamb, with a cup and ball, or spherical bearing. They are valued according to the length of the arm, at per pair, and described as wrought or cast iron.

LOCKS are mechanical contrivances for securing doors when closed, and vary in quality, description, and price more than any other branch of ironmongery. They are charged according to size and description at *each*. *Cupboard-locks* are small locks with a brass plate for fixing on cupboard-doors. Iron *rim-locks* are those in which the wards are placed in an iron box or *case*, which is screwed outside the door. *Mortice-locks* are superior in quality to rim-locks, and are let into a *mortice* cut in the edge of

the door, having a brass *face-plate* flush with the edge of the door. They are described by the thickness and length of their case. Mortice and rim locks may have one, two, or three bolts, and are described accordingly.

Furniture is the name given to the *knobs* or *handles* fitted to the lock of a door, and charged at per *set*, the quality and material being described, and also whether common or patent mode of fixing.

Escutcheon is the plate placed over or round the key-hole, made in the material of a door. A *thread* escutcheon is a narrow slip of metal let into the key-hole, and taking its exact form.

Stock-lock is a lock with a single bolt for a key only, the wards being placed in a *case* of wood or iron, and placed on the side of the door; the price depends on the size and quality.

Draw-back lock is placed on the inside of the outer doors of houses, and furnished with a knob to *draw* the bolt back; they are charged according to length.

Master-key is a key that will fit all the locks throughout a house, although the several keys of those locks will not fit any but their own locks. An extra price is charged for locks having a master-key.

The terms *dead-lock*, *bushed-lock*, *wheel-ward*, are applied according to the arrangement of the wards of locks. There is a great variety of patent locks, of various qualities and prices, the exact description of which must be given in the Bill.

Latches are lever fastenings for keeping doors closed without locking, and work on a pivot at one

end which falls into a catch at the other. *Thumb-latches*, Norfolk or Suffolk, have the latch lifted by a lever pressed upon by the thumb. *Mortice-latch* is one that is let into the edge of a door, and opens by means of a knob; the price depends on the size. *Lifting-latches* are also made of large size for church and other doors, and *lifted* by an ornamental ring.

Shutter-bars, made to fasten across folding shutters with a spring, are charged each, according to length.

Flush-lifts are let into the bottom rail of heavy sashes, for giving a hold to the fingers in opening them.

Shutter-lifts are rings let into the top of sliding or lifting shutters, for the purpose of raising or drawing them out.

Flush-rings are small brass rings let *flush* into a flap or door.

Sash-centres are fixed to the sides of a sash which is made to swing either vertically or horizontally.

Hat and *cloak pins* are single or double, either of brass or japanned iron, and are generally screwed to a *pin-rail* fixed to a wall.

Iron *meat-hooks*, tinned, for screwing to the joists, are sold at each. Brass *dresser-hooks*, for screwing into the front of shelves, are charged at per dozen.

Iron *brackets* for fastening under shelves, are charged *each*, according to length.

Brass *closet-knobs* and *turnbuckles* are charged *each*; mahogany *knobs* at per dozen.

Cabin-hooks, for securing casements when open, are charged *each*, and whether iron or brass.

Sash-fastenings, for securing hung-sashes when closed, and fixed at the meeting bars, are charged *each*, and described as common, spring-roller, or patent. There are several varieties of these articles.

Thumbscrew fastenings are used to secure lifting shutters, which are hung in two heights. They are provided with brass plates let flush into each shutter at their meeting, and are charged each.

SASH-LINES for connecting sashes or lifting shutters with their balance weights, are of different kinds. Those commonly used are the *flax* line and the *patent* line, which are sold in 'knots' of 12 yards, and are of various thicknesses or gauge. Besides these, there are *leather* lines and brass link chains, which are only used for very heavy sashes, and must have pulleys made to suit them. They are sold by the foot run, according to strength. Copper twisted cords and steel ribands are sometimes used for the same purpose, and are sold by the foot run.

BELL-HANGING.

BELLS, for producing sounds, whether in private houses or public buildings, are made of a mixed metal, composed of copper and tin, in the proportion of four parts copper to one part tin, which is termed *bell-metal*, and is poured into moulds of a hollow cup-shape. Bells which are intended to be swung are

fitted with clappers, generally made of iron, hung from the centre, and striking the lower part or *sound-bow* of the bell on the inside, this being its thickest part.

Large bells for churches, turrets, factories, &c., are sold at per lb. weight. They are attached to a horizontal beam, at the top or crown, called the *stock*, at the lower ends of which are metal centres, called *gudgeons*, which are let into supports, and on which the bell swings freely. The smaller-sized turret-bells are rung by means of a rope attached to a lever projecting from the top of the stock; but in large bells this lever is replaced by a wheel having a groove round its circumference, in which the rope is fixed. The tone of a bell depends upon its size and thickness; a small bell giving a higher note when struck than a large one made in the same proportions.

HOUSE-BELLS are hung for the purpose of communicating from one room to another. They are usually tuned in peals, so that every one has a different tone, and have a curved spring fastened to the crown of the bell, and attached by a spring *carriage* and brass T-plate to a *bell-board*. Copper wires are conveyed by means of cranks from the bells to the various rooms, and are concealed from view in zinc or copper tubing, embedded in the plaster of the walls. A *pendulum* is often attached to each bell, to show which bell has rung. In estimating bell-hangers' work, it is usual to *number* the bells and describe the mode of hanging, including cranks, springs, wires,

carriages, tubing, &c., in the price per bell. When the several articles are used separately, as in repairs to old work, the cranks are charged *each*, and described as purchase-cranks, mortice-cranks, either single, double, treble, or quadruple. Also the bells are charged *each*, according to size, including steel-spring, brass T-plate, and back-spring carriage. Pendulums with springs are charged *each*. Copper wire is charged at per lb.; copper or zinc tubing at per foot run. *Wheel* and *chain* apparatus, for turning corners, are charged *each*. *Lever-pulls* are the handles by which the bells are rung, and are fixed on the side of the fireplace of each room. They are generally ornamental, and with knobs to match the door furniture.

ELECTRIC BELLS are used in large houses and hotels, where the number of cranks and the great length of wire required for connecting the bells with the pulls upon the old system, renders the pulling very hard, and the liability to get out of repair very considerable. When electricity is employed there are no mechanical actions or cranks, and no motion required from the wires. The electricity is generated in a sand battery charged with dilute acid every six or twelve months. The rooms are supplied with bell-pulls, ropes, levers, or knobs, from which are brought two flexible copper wires covered with silk, and which act as conductors of the electric fluid from the battery to the bells. A single bell is sufficient for any number of rooms, and is connected

with an indicating tablet, which has the name or number of each apartment marked upon it. When a lever is pulled in any room, the bell rings, and a red disc appears at the aperture on the tablet corresponding to the number or name of the room.

CHAPTER VIII.

PLUMBING, ZINC-WORKING, GAS-FITTING.

PLUMBING.

PLUMBERS'-WORK or PLUMBING is all that part of the construction of an edifice which relates to the use of *lead*, and also to the supply of water to the building. *Milled-lead* or lead rolled out in sheets is used for covering roofs and flats, for lining gutters and cisterns; and for all other purposes where lead in sheets is required: it is described according to weight per superficial foot, the thinnest weighing about 4 lbs. to the foot. In using lead on roofs or flats, a covering of boards is first laid, and on this are nailed a number of parallel *rolls* of wood, 2 or 3 ft. apart, running from top to bottom of the roof; the lead is then cut in strips somewhat wider than the distance apart of the rolls, the edge of one strip dressed over the roll, and that of the next strip dressed over the first, so as to make a water-tight joint; the lead is kept from being raised up by the wind by *lead-headed* nails driven through the lead into the rolls. Lead should never be used in very

large sheets, as it is liable to crack; it is therefore usual, when a large roof is to be covered, to make the sheets in short lengths and *lap* them one over the other. When used on flats or roofs of low pitch, a *drip* or step of about 2 inches is formed at the bottom of each sheet, the upper end of the lower sheet is turned up against the drip, and the lower end of the upper one turned down over it. The same plan is adopted in forming lead-lined gutters.

When lead is used to form the covering of the ridges and hips of slated-roofs, a ridge-roll of wood is first fixed; then the lead is dressed over it, secured with lead-headed nails, and laid several inches over the slates on each side.

Flashing is a strip of lead laid upon a roof where it abuts against a wall; the lead is turned up against the wall, and the upper edge protected from weather by a lead *apron* let into a groove or joint in the wall, and hanging down 2 or 3 inches over the flashing. *Stepped-flashing* is where the lead is cut out in steps and turned into the joints of the wall, following the slope of the roof. Flashing is secured to the wall with *wall-hooks*.

The valleys of slated roofs are lined with lead laid upon valley boards; the lead goes under the slates on each side at least half the length of a slate.

The lowest end of a lead gutter is formed into a box called a *cesspool*, to collect the water over the fall-pipe head. The lead of a gutter must always be laid as much as half the length of a slate (at least) under the eaves of the slates; and in order to pre-

vent melting snow from getting in between the lead and the slates, a grating of wood or metal is placed across the gutter a few inches above it, so that the snow on the top of the grating in melting is carried off by the gutter below.

LEAD CISTERNS are made of wood and lined with milled-lead, the bottom being generally of stouter lead than the sides; the lead is *soldered* along all the joints with *solder* made of equal proportions of tin and lead.

Plumbers' work is valued according to the market price of lead, at per cwt., to which must be added the labour; for this, however, we have not sufficient data on which to base a set of constants for this description of work. Lead-headed nails, wall-hooks, and holdfasts, are charged per piece; clout nails, by the hundred. Solder is sold by the pound, joints being charged separately from the lead itself.

The following is the thickness of milled lead according to its weight per foot superficial:—

Milled lead weighing	4	lbs. per foot,	measures	·067	in. thick.
" "	5	"	"	·084	"
" "	6	"	"	·101	"
" "	7	"	"	·118	"
" "	8	"	"	·135	"
" "	9	"	"	·151	"

DRAWN-LEAD-PIPE is used for conveying the water supply to the different parts of a building: it is of three qualities or thicknesses, and known as common, which is the thinnest; middling, and strong. It is charged either by weight or by the foot run; all

solder joints are charged extra at each, according to the size of the pipe; or they may be charged according to the weight of solder used.

The following is the weight of lead-pipe, according to strength and diameter of bore:—

	Common.		Middling.		Strong.	
Lead pipe of $\frac{1}{2}$-inch bore, weighs per foot,	1 lb.	0 oz.	1 lb.	2 oz.	1 lb.	7 oz.
" $\frac{5}{8}$ " "	1	2	1	5	1	9
" $\frac{3}{4}$ " "	1	9	1	13	2	0
" 1 " "	2	6	2	13	3	5
" $1\frac{1}{4}$ " "	3	0	3	8	4	5
" $1\frac{1}{2}$ " "	4	0	4	10	5	5
" $1\frac{3}{4}$ " "	6	5	7	0	8	0
" 2 " "	7	0	8	0	9	5

Iron pipes are often used for bringing water from the well or service to the house, and are made with screwed joints which are fitted with red-lead. They are charged at per foot run.

Lead should never be employed to convey or to hold soft or rain water, as it is readily attacked by the carbonic acid contained therein, and the carbonate of lead formed, which produces poisonous effects when the water is used for drinking purposes. *Socket-pipes* are used for conveying water from sinks to the drains, and also for conveying the soil from water-closets to the drains; they are made of sheet lead, which is bent round and soldered along the edges. They are charged at per foot run according to their diameter and their weight per foot superficial of lead. *Funnel-pipes* are made trumpet-shape, wider at top than at bottom, and act as standing-wastes in cisterns to prevent them from over-flowing; they are fitted into the waste pipe with brass *washer*

and *waste*, which are ground so as to be water-tight; they can thus be easily lifted out of their place when it is required to empty the cistern. They are charged at per foot run according to diameter, and the washers and wastes at each according to size.

A TRAP is a contrivance to prevent foul air from passing into a house from a drain by means of a waste pipe; this is effected by forming a barrier of water in the middle of the pipe. A *syphon-trap* is the simplest form, being a dip made in the pipe, so that while water will pass along it to the drain, a quantity of it always remains in the dip or syphon, and prevents the foul air from returning. A *bell-trap*, used in sinks and in sink-stones to areas, consists of a raised circle let into the stone so as to form a reservoir of water; a movable *bell* attached to a grating is dropt over it and effectually traps the waste pipe by the edge of the bell dipping into the water below; it is kept clean by occasionally lifting up the bell.

D-*traps* and P-*traps* are those which are made of lead of the form of the letters D or P to receive the soil pipe from the basin of a water-closet and stop the return of foul air from the drain; they are placed immediately under the closet apparatus. Cast-lead traps are also made in one piece, to serve the same purpose.

COCKS are used for turning water off and on from supply-pipes; they are of various kinds, as bib-cock, stop-cock, ball-cock, &c. *Bib-cocks* have the outlet hanging down, and are turned off and on by hand;

they are used for drawing off water from pipes. *Stop-cocks* are placed in the middle of a pipe for cutting off the supply of water; they are turned by hand or by means of a spanner. *Ball-cocks* are similar to bib-cocks, and are used for supplying cisterns, having a hollow metal ball attached by means of a lever which regulates the supply; the ball being hollow floats on the surface of the water, and as it rises gradually turns the ferrule of the cock, so as to cut off the supply when the cistern is full. Cocks are generally made of gun-metal, and a cheaper sort of galvanised iron.

PUMPS are employed for drawing water from wells to supply a house. The common *suction-pump* is fixed in the place where the supply is required to be drawn, and is connected with the water in the well by a pipe; it will not draw water more than 30 ft. in height. When the surface of the water in the well is deeper than 30 ft. from the top, a *force-pump* is used, and is placed in the well near the surface of the water; it is worked either by an ordinary handle or by a wheel to which a handle is attached, and the water can be forced to any part of the building. The size of the pump must depend upon the supply of water required to be delivered in a given time, which is proportional to the area of section of the barrel of the pump, or to the square of the diameter. Thus, a 2-in. pump worked 25 strokes per minute with 9-in. stroke, will raise 154 gallons of water per hour; a 2½-in. pump will raise 240 gallons; a 3-in. pump will raise 346 gallons, and so on. The pipes

must also be in proportion to the size of the pump, a $2\frac{1}{2}$-in. pump requiring a $1\frac{1}{4}$-in. pipe, a 3-in. pump a $1\frac{1}{2}$-in. pipe, a $3\frac{1}{2}$-in. pump a $1\frac{3}{4}$-in. pipe. When a large supply of water is required to be raised quickly, a double or treble barrel pump is used, the quantity of water being proportional to the number of barrels. In deep wells stages are fixed at every 12 ft. depth, and are fitted with *roller-guides* for the rods to pass through. A copper *air-vessel* is sometimes fitted to force-pumps, in order to give a continuous stream of water and to assist the working of the pump. Pumps are charged at each, according to their diameter and description; the rods, wheels, and framework are charged extra, according to the depth of the well.

WATER-CLOSET APPARATUS are of various kinds, the simplest being a pan or basin, made of glazed ware, having a syphon-trap attached at the bottom to connect with the soil pipe or drain. There is an opening in the upper part of the pan, to which a water pipe can be attached for the purpose of flushing out the basin. Another kind of closet has a *valve* let into a socket in the cistern above; this is raised by means of a handle, to which is also attached a *copper pan* fitting under the basin; a lead *service-box* is fixed to the bottom of the cistern under the valve, to supply a sufficient quantity of water after the valve is closed. Other kinds of apparatus are made to work without any valve in the cistern, or service-box, having a *regulator* attached to the apparatus itself; these can be placed at any distance from the cistern, and do not require to have one provided

especially for them. *Self-acting* water-closets are those in which the valve which regulates the water supply is worked by means of the door or seat. When worked by the latter, the seat is hung on hinges, and a slight depression caused by the weight of the person using it opens a valve by which a regulator is filled with water, and this is discharged into the basin as soon as the pressure on the seat is removed. Water-closets are charged at *each*, according to their description and the quality of the basin and other parts.

It is usual in good houses to lay hot water to the bath-rooms from a boiler in the kitchen range; for this purpose two cisterns have to be provided at a higher level than the bath-room; the one for cold water is an ordinary open cistern, the other for hot water a galvanised iron cistern entirely closed, with pipe passing through the top to carry off the steam to the outside of the house. A pipe descends from the bottom of the hot-water cistern to within 2 in. of the bottom of the close boiler in the range; a pipe from the cold-water cistern joins this pipe a short distance below the hot-water cistern, and thereby keeps up the supply. Another pipe leaves the top of the boiler and conveys the hot water therefrom to the close cistern which forms a reservoir to supply the baths; from this last pipe the hot water can be drawn off by branches to any part of the house. The ends of the pipes that enter the boiler should be of copper, and attached to the supply pipes with strong brass *unions*. The two cisterns should be fixed on the same level.

Copper is sometimes used in sheets for covering roofs, flats, or gutters; it is charged at per foot superficial according to its thickness in ounces per foot, as 12 oz., 16 oz., and 20 oz. copper; the price includes the seams, labour, ties, and nails, and is measured on the face as finished. Copper pipes are charged at per foot run according to diameter. Sheet copper weighs 549 lbs. per cubic foot.

ZINC-WORKING.

Zinc is a metal largely used in building operations, and especially as a light covering to roofs and flats. Its specific gravity is much lower than that of lead, and its weight per cubic foot is 439 lbs., that of lead being 713 lbs. It can also be used very much thinner than lead, and is consequently the lightest material that can be employed in roofing; but since its expansion and contraction are considerable, it must always be allowed plenty of *play* at the laps.

The thicknesses which are used in covering roofs, flats, and gutters, are 19 oz. to the superficial foot, 21 oz. to the foot, 24 oz. to the foot, 26 oz. to the foot, and 28 oz. to the foot. When used in gutters, the thickness should not be less than 24 oz. to the foot. Zinc should never be allowed to come in contact with other metals when exposed to the open air, as a galvanic action is liable to take place to the destruction of both metals. It is laid upon roofs, flats, and gutters, in the same way as sheet

lead; a floor of boards being first laid to receive it, with wooden *rolls* 30 in. apart. One mode of securing it to the rolls is by a *lug* attached to the underside of the *over-lap*, which lug passes through the *under-lap* and is held by a *clip* of zinc nailed to the roll. Roofs are sometimes covered with zinc without the use of any under-boarding, the sheets being secured in above manner to the top edges of the rafters chamfered off for that purpose; in this case, the rafters must not be more than 12 in. apart.

Corrugated-zinc can be laid on roofs without any boarding, the corrugations being formed at intervals of 15 in., or two in the width of each sheet, which is called 'Italian corrugation,' and wooden rolls 3 in. by 2 in. fixed to the purlins are fitted into each corrugation; the purlins may be placed 10 ft. apart. If a roof has a fall of 1 in 7 no drip is required, and only a fold at the junction of the sheets. In flats and gutters there should be a drip at every 14 ft. length at the least, and a fall of 1 in 20 should be obtained where possible.

Flashings should go 3 in. into the wall, and be pointed with cement.

Eaves-gutters require stays screwed into the eaves board or rafter-feet every 18 in. in length.

Zinc is worked into ornamental forms for ridges, hips, dormers, &c.

Zinc, when used in roofs, flats, gutters, or flashings, is measured by the foot superficial, and either the *gauge* or the weight per foot described.

Eaves-gutters, rain-water-pipes, chimney pipes, &c.,

when made of zinc, are taken by the foot run, the diameter being described. Heads, shoes, chimney tops, cowls, &c. are charged each.

Zinc nails are sold by the lb.

Galvanising, is covering iron with a thin coating of zinc by plunging it into a bath of that metal; this process prevents for a considerable time the oxidisation of the iron.

Perforated-zinc is used for filling-in to openings where ventilation is required, and is sold by the foot superficial.

GAS-FITTING.

The work of the GAS-FITTER is to convey gas from the mains to the several parts of a building by means of pipes and tubing; and great care has to be taken that all the joints are accurately made so as to prevent escape of gas. Wrought-iron welded tubing, in lengths from 4 ft. to 12 ft., is used for the principal parts of the work, the lengths being screwed into each other with a cement of red-lead. For turning corners, and changing direction, bends, elbows, tee-pieces, cross-pieces, and connecting-pieces, are screwed on to the ends of the pipes. The branches to the different burners are made with stout tin pipe, attached to the iron tubing by union-joints.

All gas piping and tubing is measured by the foot run, the diameter and material being described. Short lengths of iron pipe under 2 ft. are charged extra. All bends, joints, elbows, &c., are charged each, according to size of pipe.

Before the gas is brought into a building it is passed through a *meter*, or apparatus for measuring the quantity of gas consumed. Meters are of two kinds, *wet* and *dry*; the former containing water which the gas displaces, thereby causing the revolution of a drum which moves an index: they are now generally discarded in favour of the *dry* meters, which indicate the quantity of gas passed through with greater accuracy. The price of meters depends upon the number of *lights* or gas-jets intended to be burnt, and are named 5-light, 10-light, 20-light meters, &c. accordingly.

Gas pipes should always be laid with a fall towards the meter, so that if any water gets into them it may be more readily passed off. The size of the pipes must be regulated by the quantity of gas required to be consumed, which is measured in cubic feet; a pipe of $\frac{1}{2}$-inch bore will deliver 90 cubic feet of gas per hour; one of $\frac{5}{8}$-in. bore, 160 ft. per hour; one of $\frac{3}{4}$-in. bore, 250 ft. per hour; one of $\frac{7}{8}$-in. bore, 380 ft. per hour; one of 1-in. bore, 500 ft. per hour; one of 2-in. bore, 2000 ft. per hour; and so on, according to the square of the internal diameter of the pipe.

CHAPTER IX.

PAINTING, GLAZING, PAPER-HANGING, DECORATING.

PAINTING.

THE work of the PAINTER is to cover with colour woodwork, ironwork, plastering, or any other material, either for the purpose of protecting it from the action of the weather and atmosphere or of producing an ornamental and decorative appearance. Work that is intended to receive paint is generally prepared beforehand, with that object in view; thus, joiners'-work which is to be painted is sand-papered *across* the grain, when finished by the joiner, so as to give a hold or *key* for the paint; if it is to be stained and varnished so as to show the grain of the wood, it must not be touched with sand-paper, or at least very slightly, and that only *with* the grain of the wood.

Iron and other metals must be carefully cleaned from all rust or oxidisation before being painted; and wrought-iron should be coated while warm with linseed oil, to protect it from the moisture of the air.

Plaster or stucco must be thoroughly dry before being painted, otherwise the work will blister and the paint be thrown off.

When deal is to be painted it is first KNOTTED, or the knots of the wood *killed* by being covered with a knotting, composed of white and red lead mixed with whiting in a solution of size.

PRIMING is the first coat of paint after the knotting is dried, and is done with red-lead and linseed oil, mixed with white-lead. All nail holes are at the same time stopped with putty. For the other coats white-lead, linseed oil, and turpentine are the chief materials employed, with which various pigments are ground up to give the required tint to the work.

FLATTING is the finishing of painted work a *dead* colour, which is done by using a considerable proportion of turpentine in the last coat.

Each coat of paint should be thoroughly dried before the next is applied; and for good work the surface is *rubbed-down* with pumice-stone before each coat of paint is laid on, so as to impart great smoothness to the work.

When old work is to be repainted it is first washed and rubbed down with pumice-stone and water, until an even surface is obtained; and if there are great inequalities they are filled up, or *brought-forward*, with a cement or putty.

Before painting the plastering on the inside walls, it is first covered either with boiling linseed oil, or with white-lead and oil mixed with litharge to the consistence of thin cream; the oil is absorbed by the plaster, and when the first coat is dry a thicker one is applied, of which the oil is only partially absorbed; each coat after is made thicker and thicker until the

oil ceases to be absorbed and the surface becomes thoroughly hardened.

Carbonate of lead, called *white-lead*, is the chief ingredient in all paint, but is often adulterated by the admixture of carbonates of lime and baryta, whiting, gypsum or plaster-of-paris, pipe clay, starch, flour, &c.

Zinc-white has less body than lead-white, but possesses greater whiteness and power of resisting sulphurous gases.

MASTIC is a kind of cement used to lay over other cements, or to repair defects therein when it is to be painted. It consists of a mixture of pounded brick-dust, limestone, and sand; oil is used in its mixing and using, so that it may be painted upon as soon as laid. It can only be used in thin coats, and requires frequent painting to replace the oil which is lost by evaporation.

CLEARCOLE is a cheap kind of painting done with a mixture of white-lead, water, and size; a coating of this dries quickly and may be finished with a coating of white-lead in a mixture of equal quantities of oil and turpentine, having some colour and a *dryer* added thereto.

DISTEMPER is whiting mixed with a solution of size, and brushed over the work.

When painted work is to be MARBLED OR GRAINED, the last coat is done in equal proportions of oil and turpentine of the colour which characterises the wood or marble to be imitated. The *graining* is done by thin glazings of colour ground in water and mixed

with small-beer, the grain being imitated by means of a comb. Oak-graining is done with colour in turpentine and varnish laid over the work, and combed while wet. The lights are taken out with a small brush, or a rag moistened with turpentine; it is then glazed over with colour in beer, or *over-grained*, and the surface covered with copal varnish.

Wood-work that is to be STAINED so as to show its natural grain, must be of material carefully selected, free from loose or dead knots, sap-wood, or other defects, and its surface finished with the tool only. It is coated with a solution of a pigment in water which is absorbed by the wood, then once or twice sized over, and varnished with copal.

FRENCH-POLISHING is a varnish rubbed over hard woods previously prepared, until they present a highly-polished surface.

To CLEAN old painted-work, soap and water is laid on with a large brush, and washed off with a sponge; it is then dried with a leather.

External painting executed in the autumn will last twice as long as that which is done earlier in the year; as the summer sun draws out the oil from that which is done early.

ABBREVIATIONS.

1 O 2 O 3 O 4 O 5 O 6 O	Number of times in oil common colour.
F	Flatted, as 3 O F three times in oil and flatted.
D W	Dead white.
F G	French grey, or the particular colour may be written.
C C F	Clear colour and finish.
G W	Grained wainscot.
G M	Grained mahogany.

ROTATION.

In measuring painters' work, first take the windows; secondly, the skirting, dado, or wainscoting; thirdly, the chimney-pieces, if painted; and lastly, the doors.

MEASURING.

In measuring painters' work, all work not cut-in on both edges, must be taken, including edges and projections, at per yard square of 9 superficial feet.

Work cut-in on both edges, as skirtings, cornices, shelves, &c., is measured at per foot run.

Ornamental work first taken as common, and then the extra labour to ornaments at per foot superf. or run.

Sash frames, window lights, casements, bars, dormers, frontispieces, chimney-pieces, &c., numbered and valued at each. Sash squares at per doz.

Iron or wood railings, balusters to stairs, &c., are measured on both sides as solid work, to allow for the extra trouble of painting round the bars, rails, &c., at per yard.

If ornamented, add extra one face in the width of such ornamental parts.

If ornamented turned balusters, also add one extra face as far as the turned work goes.

Handrails, &c., grained mahogany, first measure them in with the balusters, and then per foot run for graining.

Soffits to windows per foot run.

Letters or figures numbered and valued at per inch in height.

Windows and doors are measured thus :—(See Plate 8.)

WINDOWS (fig. 4).

ft. in.	ft. in.	
11 0 5 5		Window front.
7 10 6 0		Shutters: ft. in. 7 6 height, 0 4 edges. = 7 10; ft. in. 4 6 width, 1 6 boxings and edges. = 6 0
20 3 1 2		Linings: 7 6, 7 6, 0 9, 4 6 = 20 3. If the backs are cut away, the linings must be measured to the floor, thus: 10 6, 10 6 linings; 4 9 soffit; 0 6 elbows = 26 3; viz. ft. in. 26 3, 1 2
22 6		Beads varnished, supposing them to be mahogany or wainscot sashes and beads: 7 6, 3 9 = 11 3; 11 3 = 22 6
		12 squares varnished. 1 locking bar.
		Some only allow the shutters' width to be taken thus:— 1 6 boxings. 0 6 edges. = 2 0; 3 9 shutters. = 5 9 instead of 6 feet.
		The outside of window would be taken as . . . N 1 frame; 1 dozen of squares; 1 sill, if the stone sill is painted.

DOORS (fig. 5).

ft. in.	ft. in.	
2)7 0 4 4		Door fronts for both sides: 4 0 width.; 0 4 projection of architraves. = 4 4
16 0 0 8		Linings: 6 6, 6 6, 3 0 = 16 0; 0 6 reveal.; 0 2 edge of door and rebate. = 0 8

ABSTRACT.

Once in Oil.				Twice in Oil.				Three Times in Oil.				Four Times in Oil.				Five Times in Oil.			
Com.		Runs.	Nos.	Com.		Runs.	Nos.	Com.		Runs.	Nos.	Com.		Runs.	Nos.	Com.		Runs.	Nos.
And Flat.				And Flat.				And Flat.				And Flat.				And Flat.			

By this method every description of work stands in rotation in the Abstract as it should be drawn into Bill, and will likewise be found with much more facility on the Abstract.

ROTATION.

To be attended to in bringing the quantities into Bill.

PAINTER.

Yds. ft. in.				
	Once in oil			
	Run of Skirting, &c.			
	No. Sashes. Doz. squares . .			
	Twice in oil			
	Runs			
	Numbers			
	Three times in oil . . .			
	Runs			
	Numbers			
	Three times in oil and flat dead white			
	Runs			
	Numbers			
	If carved work, or any other per foot superf., it must be put under the yards of painting so many times done.			
	Likewise party or other coloured work must be placed under the head of work according to the number of coats.			

VALUATION OF PAINTERS' WORK.

CALCULATION OF MATERIALS.

45 yards of work, 1st coat, including knotting, stopping, and every preparation requisite for the second coat, will require	5 lbs. of white-lead. 5 lbs. of putty, litharge, &c. 1 quart of oil.
Second and following coats	5 lbs. of white-lead. 1 quart of oil.

20 per cent. profit is always allowed on the prime cost of the materials.

CALCULATION OF LABOUR.

The decimal to be multiplied by the rate of wages for a painter per day:—

First coat, including stopping, &c. . .	·027
Second and following coats . . .	·019

The above data will suffice for the valuation of common work, for which alone it is possible to lay down any rules, as the value of decorative work, such as graining, imitations, &c., depends upon the ability of the artist, and the manner in which the work is executed.

GLAZIERS' WORK.

The work of the glazier, called GLAZING, consists in fitting glass in sashes, frames, and casements, and fixing it either in putty or in lead. The glass used in buildings is of various kinds; the commonest sort is

denominated CROWN-GLASS, of which there are three qualities, called best, seconds, and thirds. Being a blown-glass, it is liable to air-bubbles, blisters, specks, and other defects; the *best* is that which is freest from these blemishes; *seconds* and *thirds* are commonly used for window glazing, the latter, however, only for very common windows. It is all sold at the same price per crate, but the number of *tables* is different, according to the quality. There is another quality called *fourths*, of a very coarse description and very little used. Crown-glass weighs 158 lbs. per cubic foot.

SHEET-GLASS is a superior kind of blown-glass and made of much larger sizes than crown, and also of a purer quality or *metal*; after being blown in the form of a cylinder, it is cut lengthwise and unrolled or *flatted* in a furnace, and has rather an uneven surface; there are four qualities, named as in crown-glass, and six different varieties of thickness, according to the weight per square foot—namely, 15 oz., 21 oz., 26 oz., 32 oz., 36 oz., 42 oz.; of which the thicknesses are respectively, ·071 in., ·100 in., ·124 in., ·150 in., ·171 in., ·200 in. It can be had in all sizes up to 17 sq. ft. in area, the price per foot of the squares increasing with their area. Polishing is charged extra at per foot superficial.

PATENT-PLATE GLASS is a superior quality of sheet glass polished on both sides; it is of two qualities and of four different thicknesses—namely, $\frac{1}{16}$th in., weighing 13 oz. per sq. ft.; $\frac{1}{12}$th in., weighing 17 oz.; $\frac{1}{10}$th in., weighing 21 oz.; and $\frac{1}{9}$th in., weighing

24 oz. per foot. It can be had in all sizes up to 12 square feet in area, but is not generally used of large dimensions, from being brittle and nearly as expensive as British-plate glass.

British-plate Glass is the best material for glazing purposes, and can be had in sheets of any size up to 90 superficial feet. It is of two qualities, *best* and *seconds*, the former being picked free from air-bubbles or other defects; its usual thickness is $\frac{3}{16}$ths in. to $\frac{1}{4}$th in. for the ordinary glazing sizes, but the larger sizes are thicker. The price at per foot superficial increases with the sizes of the squares and also with the thickness. If the edges are ground or polished, they are charged at per lineal inch.

Bending glass to a particular sweep is charged extra at per foot superficial.

Rough-plate Glass is a common kind of material used for skylights, &c.; it is made either *plain* or *fluted*, and of various thicknesses, the usual being $\frac{1}{8}$th in., $\frac{3}{16}$ths in., $\frac{1}{4}$th in., $\frac{3}{8}$ths in., and $\frac{1}{2}$ in.; and in sizes up to 30 feet superficial, the price per foot increasing with the dimensions. There is also a thin rough glass made with perforations for ventilation.

Rolled-Cathedral is a rough kind of glass made in various tints, and used for forming stained-glass and other windows of churches, &c.

Glazing or fitting glass into sashes is commonly done by bedding the glass in *putty*, formed of whiting mixed with white-lead and linseed oil; when the sheets are of large size and extra thick—as plate glass—it is usual to secure them with small iron

sprigs or brads in addition to the putty. Whe glass is fitted into iron sash-bars, a coating of tw parts resin to one part tallow laid on the bars whe hot, will prevent the putty from cracking by th changes of temperature.

In fixing glass into stone-work, a groove is cut i the stone which is coated with size, and the glass i bedded in common putty in which a little olive oil i mixed, to prevent it from getting too hard. Th size prevents the oil from staining the stone. Glazin in *lead-lights* is done by fitting pieces of glass int slips of lead grooved on each side ; the groove i filled with dry whiting mixed with a little white-lea and painted over with oil, so as to form a cement fc the glass. Lead-lights are let into grooves cut i the stone-work and secured to iron saddle-bars wit copper ties soldered on to the leadwork. They ar measured by the foot superficial, the price varyin according to the quality and design of the glass usec

Hacking-out old glass from sashes is charged extr at per foot superficial.

In measuring glaziers' work, the dimensions mus be taken between the rebates, and all irregular pane the extreme size each way. The price per foot (glazing with crown-glass must be calculated from th prime cost per crate, allowing for carriage and 20 p(cent. profit. The larger the panes are, the more di ficulty, risk, and waste; consequently the price shoul increase in the following proportions :—

	ft. in.	ft. in.		
Panes whose superficial contents are . . . . under		2 0 at per foot.		
Do. do. do. do. from	2 0 to	2 6 add 1*d*.	Above the squares whose contents are under 2 feet.	
Do. do. do. do. do.	2 6 to	3 0 add 2*d*.		
Do. do. do. do. do.	3 0 to	3 6 add 3*d*.		

A CRATE OF CROWN-GLASS

Contains 12 tables of the best, at per crate
„ 15 „ seconds „
„ 18 „ thirds „
„ 18 „ fourths „

Each table is from 4 ft. to 4 ft. 6 in. diameter: some tables may be cut to within 2 in. of the centre, others not nearer than 4 inches.

	ft.	in.
Supposing a crate to be 4 ft. 6 in. diameter, and that it may be cut to 2 in. from the centre, the quantity of glass that may be cut from it, including the triangular pieces, will be	14	2
If only 4 ft. diameter, and cannot be cut nearer than 4 in. of the centre	10	10
	25	0
And deducting the triangular pieces, which are of very little value	2	6
We have as the available contents of the two tables .	22	6
The average contents per table	11	3

taking the sizes of squares that will cut to the most advantage: but as squares of all sizes must be cut from the tables as they are wanted, the average produce per table is not more than 10 ft. superficial.

Labour and putty per foot may be found by multiplying the rate of wages for a glazier per day by the decimal ·110.

Example.—To find the value per foot of glazing, with best Newcastle crown-glass, or any other kind of glass:—

	£	s.	d.	
Prime cost of crate (12 tables)	0	0	0	
Carriage, &c.	0	0	0	
	0	0	0	
20 per cent. profit	0	0	0	
Divide by No. of feet the crate will produce, for best glass . . . . . . 120)	0	0	0	
	0	0	0	per foot.
Labour and putty	0	0	0	
Total per foot . . .	£0	0	0	

PAPER-HANGING, DECORATING.

Before newly-plastered walls can be papered they must be thoroughly dried, then rubbed down with pumice-stone and coated with size, to prevent the paste with which the paper is attached to the walls from sinking into the plaster. Old walls that have been previously papered should be stripped of all loose paper, washed, and sized. When papers of superior quality are to be hung on a new wall, a thin lining-paper is first laid on to prevent the plaster from discolouring the paper.

WALL-PAPERS are sold by the *piece*; a piece of English paper is considered to be 12 yards in length and 20 inches wide: its content is equal to $6\frac{2}{3}$ square yards, or 60 feet superficial; therefore, in measuring, divide the superficial feet by 5, which will give the number of yards running, and these divided by 12 will give the number of pieces. If there are any odd yards, they

are charged as one piece. It is customary to allow one piece in seven for waste. Common papers do not measure more than 11 yards nett to the piece. French papers are of various widths, but more usually about 18 inches wide and 9½ yards long, 4½ sq. yards being the measurement of one French piece.

Pumicing and preparing walls for papering is charged at per piece of paper, in addition to the price of the paper. Lining-paper and hanging the same, at per piece. Hanging the paper, at per piece, the price varying somewhat with the quality. Marbled papers are hung in blocks and lined round with a pencil; sizing and varnishing is charged at per yard superficial.

Borders fixed at top or bottom of the papering to a room are taken at per dozen yards run, and the hanging of them in the same way.

When walls are damp, or are liable to wet coming though from outside, they are sometimes covered with sheets of tin-foil before being papered; this is charged according to the quantity used and the time occupied in hanging.

Where there are hollows in a wall to be papered, as in old wainscotting, they are covered with canvas, on which the paper is hung.

Gold or other mouldings placed next the cornice or plinth, are charged at per foot run, and are attached by means of needle points.

DISTEMPERING is done with colour mixed with a solution of size, and is washed over walls and ceilings; it is charged at per yard superficial, the price

varying with the tints used; and if the cornices a ornaments are cut-in of different tints, they are tak separately at per foot superficial. The gilding mouldings or ornaments is taken at per foot ru according to their girt. Imitations of marbles a measured by the foot superficial.

FRESCO-PAINTING is performed by employing colou mixed and ground with water, upon a stucco, plaster, sufficiently fresh and wet to imbibe a embody the colours with itself, so that the painti dries along with the plaster, becomes very durab and brightens in its tones and colour as it dri This kind of work must be done upon walls that a perfectly dry, and not liable to be affected by e ternal damp; it is unsuitable for any but toleral dry climates.

SCAGLIOLA is a mode of imitating in colum pilasters, &c. the most expensive marbles, and is or used for internal decorations. The column to decorated in this way is first formed of any materi 2 or 3 in. less in diameter than the finished colum this is covered with a coating of lime-and-h mortar, and allowed to dry. The material used the decoration is calcined gypsum in fine powd mixed with various colours in a solution of glue isinglass; this is laid on the pricking-up coat, a floated over with moulds to the required shape, t artist using the colours necessary to produce t imitation during the process of floating, so t they become incorporated with the surface. Wh thoroughly hard and dry, the surface is rubbed w

pumice-stone, being kept damp during the process; then polished with tripoli and charcoal applied with linen rag, and after being gone over with felt dipped in a mixture of oil and tripoli, it is finished by the application of pure oil.

MOSAIC-DECORATION consists in covering flat surfaces with small squares made of vitrified pastes to which every possible variety of tint is given; these squares, called *tesseræ*, are arranged in various patterns according to the design of the artist, and are firmly embedded in cement; their size will depend upon the distance which they are to be placed from the eye, and upon the character of the decoration. When mosaic-work is used for paving floors, a basis of concrete is first formed, in order to obtain an even and firm surface; and the tesseræ or tiles are cut into other shapes than squares, for convenience of arrangement and laying. Mosaic-work is measured by the superficial foot, but the price varies very greatly, according to the character and intricacy of the design.

ENAMELLED-SLATE is a material used in decoration, the surface of slabs of slate, which have been rendered perfectly smooth, being coloured and polished in imitation of various marbles. These slabs vary from 1 in. to 2 in. in thickness, and are charged at per foot superficial, the price varying somewhat according to the kind of marble imitated; there is also an extra charge for moulded work. This material is also used for boxed chimney-pieces, the price of which depends on the width of piers,

jambs, and openings, and upon the amount of moulding and carving.

MARBLE is a material used for decorative purposes, but principally for *internal* work, as it loses its polish and beauty by exposure to weather, and is therefore generally unsuitable for *external* decoration. Marble in the rough is sold in blocks like any other stone, at per foot cube, the price varying according to quality and rareness; those most highly priced being the pure white *statuary*, the *sienna*, and the *verd-antique*. Marble when used for chimney-pieces and other decorations, except columns, is cut into slabs from $\frac{3}{4}$ in. to $1\frac{1}{2}$ in. in thickness, and highly polished. When used in slabs it is charged by the superficial foot, according to thickness and quality. Working or moulding the edges is charged at per foot run; rounded corners and other small matters are charged each. Copper cramps are let into the edges of slabs for fixing them to walls. Marble *columns* are turned and polished, either parallel throughout, or diminished and with an *entasis* or curved outline. The price of marble columns is charged at per foot in length according to the diameter, and whether straight, diminished, or curved. In large columns there is a considerable difference in price, whether made in a single block or built up of several stones; also if a fillet and hollow are worked on the top and bottom of the shaft, rendering it necessary to *sink* the shaft for them; instead of being worked-in with the cap and base.

POLISHED GRANITE is used for decorative purposes,

both outside and inside a building. Being very durable and preserving its polish when exposed to weather, it is chiefly employed in *external* decorations. There are several kinds of granite, varying considerably in colour, the two principal ones being the *red* and the *grey* granites. It is manufactured into slabs, mouldings for doorways, &c., columns of all sizes and forms, balusters, &c. Since granite possesses greater resistance to crushing than any other kind of stone, columns of this material are employed where a great load has to be supported on a small basis, as in piers to the nave arches of churches, and other arcades of a similar description.

LOOKING-GLASSES form an important feature in the decorator's work, being frequently let into panels, and used to fill up the spaces or piers between windows; they are made of the very best quality of plate-glass, covered at the back with an amalgam or alloy of mercury and tin, which is called 'silvering,' and causes the glass to reflect the image of any object placed before it. Silvered-glass is charged at per foot superficial, the price increasing with the size.

GILDING to inside work is done in oil-size on woodwork, and in water-size on plaster; it is executed with gold leaf, which is made up in books, one book containing 25 leaves 3⅛ in. by 3 in., which will cover about 1 ft. superficial of plain work. Gilding in quantity is charged by the square foot, and mouldings by the foot run according to size. Iron or other metal must be painted before being gilded.

CHAPTER X.

WARMING, VENTILATING, REVOLVING-SHUTTERS, SUNDRIE

WARMING AND VENTILATING.

THE simplest and most primitive mode of WARM an apartment is by means of an *open stove* or *gr* this is connected with a chimney, by which the sm produced from the burning fuel is carried off. order that a fire may burn properly, it is necess that a certain amount of air should be admitted the underside of the grate; this is commonly d by the crevices in the doors and windows thro which the air finds its way, but at the same t produces a disagreeable draught to the feet of p sons sitting in the room. When the crevices ab named are carefully closed, and all draughts cluded from doors and windows, it is necessary provide a supply of air to the stove by other c trivances; this can be done by gratings in the or in the hearth, which are connected with air-pi or flues carried to the outside of the building. the air in a room becomes warmed it expands rises towards the ceiling, its lightness being in p portion to its temperature, so that the air near floor is generally colder than that above; and as

air near the ceiling becomes cool it descends towards the floor, thereby keeping up a constantly ascending and descending current. Since the air exhaled from the lungs of persons in a room is vitiated, it is desirable to remove it from the apartment; the simplest contrivance for doing which is a *valve* with a balance weight let into the chimney flue near the ceiling; the draught caused by the fire drawing the air out of the room through the valve, and taking it away up the chimney. As, however, soot is liable to return into the room through this valve when the fire is not lighted, it is sometimes let into a second flue carried up alongside of the smoke flue, the heat from which causes an ascending current in the other flue. Cold air should always be let into an apartment from the *top* of the room, since, being heavier than the warmer air therein, it gradually descends through it, becoming warmer and warmer by contact and diffusion. There are several modes of effecting this, the simplest being by opening the window at the top, but this generally causes too great a draught to be agreeable; and it is better to have a number of perforations in the ornamental parts of the ceiling, through which air is brought from the outside by pipes or flues; valves may be provided for regulating the quantity of air admitted. In order to carry off the vitiated air from rooms when the fire is not lighted, valves or gratings may be placed near the ceiling and let into flues which communicate with a furnace flue kept constantly in action.

The open grate being insufficient for warming very

large apartments, *close* or PEDESTAL stoves of various kinds are employed; these, by their radiation or by currents of air carried over their heated surfaces, diffuse the heat generally through the room, the air being conveyed to them directly from the outside. The price of stoves depends on their size and the cubical contents of the rooms to be warmed by them. When these are used separate means for ventilation must be provided, and for drawing off the vitiated air, as in the manner above described. For large public halls and other buildings, in which persons congregate in considerable numbers, a WARMING-APPARATUS is usually placed outside the apartment, and the warm air forced or drawn in through gratings near the floor, from which it rises in a column to the roof or ceiling, where it disperses and gradually diffuses throughout the whole building, raising the temperature of the air as it descends again; the cold air is drawn out by another grating near the floor connected by a flue with the apparatus. The *apparatus* for warming the air is placed in a chamber below the apartment to be warmed, and consists either of iron plates heated by contact with fire-brick furnaces, or of pipes filled with hot water. Apparatus of this description are charged according to the cubical contents of the building which they have to warm.

Hot-water pipes are often laid under the floors of public rooms, and gratings placed over them; the heat radiated from the pipes warms the air, which ascends and diffuses through the room. These pipes

vary in size according to the system employed; when the water is not raised above the boiling point, or the *low-pressure* system is used, the iron pipes are from 2 to 4 in. in bore, and in 6 ft. and 9 ft. lengths, fitted with socket joints, and having elbows, tee-pieces, syphon-bends, &c., for carrying them round corners and changing their directions. The pipes are charged at per yard length, according to diameter, and the elbows, &c., at *each*. A small wrought-iron boiler is employed for heating the water, and a small iron tank for feeding the same. When the high-pressure system is used, or the temperature of the water in the pipes raised above boiling point, iron pipes about 1 in. bore and very strong are employed, and care must be taken that they do not touch any woodwork. These pipes can be carried into all parts of a house and concealed behind gratings in the skirtings, &c., a stop-cock being provided to each room, so that the circulation may be cut off from it when required. In all these methods the ventilation must be provided for separately; and this is generally done in new buildings erected with this object in view, by air flues connected with the smoke-flue from the furnace of the apparatus, into which there are openings near the ceiling of each room. The smoke from the furnace can be taken up an iron chimney-pipe fixed inside a large air-flue, the air in which being heated thereby is kept constantly ascending with great force, and thereby drawing the vitiated air out of the several apartments from which flues are connected with it.

The warming and ventilating of PRISON-CELLS is managed by bringing the warm or fresh air into the cell through a grating near the ceiling, and drawing it out by another grating near the floor in the opposite wall.

A mode of VENTILATING adopted occasionally in large rooms placed immediately under the roof of the building—as factories, meeting-halls, &c.—is by means of a tube of considerable size, fixed through the roof and descending into the room; this tube is divided down the middle into two compartments and termed a 'syphon-ventilator,' since the external air, when there is not a high wind, descends by one side of the tube, and the internal air ascends by the other side, thereby keeping up a constant change in the air of the room. The top of the tube above the roof is covered over with a cap, so as to protect it from the weather, and under this the air can pass both ways. A valve is placed in the tube so as to allow of the ingress and egress of air being regulated. When the atmosphere is in violent motion from a high wind, the syphon system often refuses to act, the external air descending *both* sides of the tube upon the heads of the occupiers of the room. The diameter of the tube, which is generally made of zinc, depends on the cubical contents of the room to be ventilated. The same principle of ventilation is applied when the upper part of a sash is made to swing upon centres, a double current of ingress and egress being thereby produced.

To draw the vitiated air from the upper part of a

room, the SUN-BURNER is very useful; this consists of a cluster of gas-burners arranged in circles under a reflector, above which is a tube for conveying the products of combustion to the outside; in this tube a strong upward current is produced by the great heat from the burners, by which the vitiated air is drawn out, and the room effectually lighted at the same time.

REVOLVING-SHUTTERS.

REVOLVING-SHUTTERS are shutters made to coil upon a roller placed out of sight, and worked up and down by means of gearing. These shutters are formed of strong laths, made either of iron or wood, which are attached together by hinges, so that they can be readily wound over a roller. The roller is placed either at top or bottom of the window, according to convenience, and the shutter wound upon it by means of *worm-and-wheel*, or by *chain-winding* gear. Another mode is to wind the shutter *horizontally*, and is sometimes employed in circular bay windows of first-class mansions. These shutters can be fitted either on the inside or the outside of a window, but are more commonly placed outside.

The following is the space occupied by revolving-shutters when coiled up, a small additional space being required for clearance, of one or two inches, and rather more if coiled *below* the window:—

Windows	5 ft. high	require	6¾ in. for iron,	and	8¾ in.	for wood.
„	7	„	7½	„	10	„
„	10	„	9	„	12	„
„	12	„	10	„	13	„

Self-coiling shutters are made to coil by means of a *steel-band* passing through all the laths, if of wood, and causing the shutters to coil and uncoil by merely pressing the end up or down as the case may be. *Steel self-coiling* shutters are made in one sheet of corrugated steel, and are worked up and down by the hand without balance-weights or gearing.

The following is the space required for self-coiling shutters when rolled up:—

Windows	6 ft.	high require	9 in.	for wood, and	8 in.	for steel.
„	8	„	10	„	9½	„
„	10	„	12	„	10	„
„	12	„	13	„	12	„

Self-coiling shutters are unsuitable for windows of great width, but the revolving-shutters can be applied to any width of window in one piece.

The Louvering Shutter-blind is a combination of the principle of revolving-shutter with that of the outside Venetian-blind; it is made with laths either of iron or wood similar to those above described, but jointed in such a manner that they can be either closed firmly on each other, or opened at any angle; and this can be done in any position of the shutter. These shutter-blinds are made either to *coil-up* or to *lift-up* like an ordinary Venetian-blind. When let down and closed they present the appearance of any other revolving-shutter, and when it is required to admit light or air into the window, a simple movement inside louvers the laths, or sets them at any angle with each other.

Revolving and coiling shutters are measured by

the foot superficial, and priced according to material and gearing; an additional charge per foot is made for shutters under 50 feet area. In measuring, the full width is taken, which is 2 inches more than the *sight* measure; and the height is 9 inches to 12 inches more than the sight measure, in shutters working vertically.

In measuring shutters which work horizontally, the actual dimensions are 6 inches in height and 9 inches in width greater than the sight measure.

In preparing for revolving-shutters, provision is to be made for the easy removal of all linings and casings, so as to allow of access to the shutters, shafts, and gear, which require occasionally to be oiled, cleaned, or repaired.

SUNDRIES.

LIGHTNING-CONDUCTORS are formed of copper-ropes from $\frac{3}{8}$ths in. to $\frac{5}{8}$ths in. diameter, fixed with holdfasts to the highest point of a building, and taken down into the ground for the purpose of carrying off the electricity from the atmosphere, and preventing it from striking the building. The rope is buried two or three yards below the foundation and about the same horizontal distance from it. The top of the rope is finished with *copper-points* gilt over. The copper-rope is charged at per foot run, according to its diameter; the points and holdfasts at *each*. Glass insulators are sometimes employed to pass the rope through and prevent its contact with the wall;

these are charged *each* extra, but they are of no value in protecting the dwelling, as the electricity will always follow the copper as being the best conductor.

ASPHALTE is a material largely employed for building purposes, and more especially for flooring, paving, covering of flats, &c. The principal ingredient in its composition is a bituminous limestone, which is reduced to powder and mixed with sharp grit; it is then heated in cauldrons with mineral tar and reduced into a mastic, so that it can be run into moulds in the form of blocks. When required to be used, it is again melted with a small proportion of mineral tar, and poured upon the place previously prepared to receive it; or it is laid on in a powdered state, and rendered solid by the application of hot irons. When used for floors, paving, or flat roofs, it is necessary first to lay from 3 to 6 inches of fine concrete, on which the asphalte is poured and floated over, and just before it sets a fine powder or sand may be sifted over it. In covering flat roofs the joists are fixed 12 inches from centre to centre, and plain tiles laid so as to span the distances between them; over these a thin coating of fine concrete is floated before the asphalte is applied. The weight of one square foot of coarse asphalte ½-inch thick is 6 lbs. 2½ oz.; and that of the finer quality, 6 lbs. 8¾ oz.; the weight of concrete 1-inch thick is 8 lbs. per square foot. Asphalting is measured and valued by the foot superficial, the concrete being taken separately; channels are measured by the foot run, according to width.

A cheap kind of asphalte or bitumen, which is serviceable for many purposes, can be made with gas-tar and ashes laid on cold, the surface being beaten with a rammer and sprinkled with small pieces of stone or spar. This material is measured by the superficial yard.

Boiling tar poured over a flat roof (previously covered with cement concrete) and sprinkled with ground lime and sand, will form a water-tight covering, and will also serve the purpose of stopping cracks in a roof previously cemented over.

EARTH-CLOSETS are substitutes for water-closets where there is an absence of water-supply or of efficient drainage to carry off the soil. A *receptacle* or *pail* which can be readily removed is placed under the 'seat,' and each time the closet is used a quantity of finely-sifted dry earth or ashes mixed with earth is poured into it from a reservoir above; by this means the *soil* is deodorised, and the contents of the receptacle can be emptied on the land and used as manure. When the closets are fixed in an upper story of a house, a straight pipe of earthenware or galvanised iron 12 inches diameter is attached to the bottom of the *pail*, to which there is a valve opened and closed by a handle; this pipe conveys the soil and earth down to a vault or receptacle placed below.

WINDOW-BLINDS, whether external or internal, form an important feature in the finishing of houses, the object aimed at in using them being to enable the inmates to regulate the quantity of light to be admitted by the windows. In situations which are

not exposed to a strong sunlight, *inside* blinds are sufficient for the above purpose; but where the sun shines for many hours together upon a window, *outside* blinds become necessary in addition, in order to prevent the rays of the sun from falling upon the glass, and thereby producing a large extent of heating surface, which raises the temperature of the air of the room by contact with the glass.

For *inside* blinds the simplest and cheapest are Holland *roller-blinds*, placed on wooden rollers with brass ends, which turn in brass or wooden holders; these have a pulley at one end with an endless cord passing over it, the cord also passing round a pulley below attached to a *rack*, whereby it can be tightened at pleasure. Some are fitted with self-acting spring rollers, which draw up the blinds when the catch which holds them is released. Roller-blinds are charged by the square foot, and the price depends on whether they have plain or spring rollers.

In sunny situations *inside Venetian-blinds* are mostly used; these consist of a number of thin laths attached to webbing, so as to lap one over the other, the laths being capable of being set to any angle by means of cords attached to them. These blinds are drawn up and down by means of cords passing over pullies at the top, or else by a patent action, in which a spring performs the work of drawing up the blinds, and can be stopped at any height. Venetian-blinds are valued by the square foot, measuring the opening of the window, the patent action being charged extra according to its character.

Outside-blinds are various in character, the simplest and cheapest being the Venetian-blinds, as above described for the inside, fitted into an outside case fixed between the reveals of the window. Then there are what are termed 'jalousies' or Venetian shutter-blinds, consisting of a number of laths or louvres fixed in a frame hung upon hinges, so as to open back against the face of the wall. These blinds are also made to slide upon horizontal iron rods.

The *Florentine* and *Spanish* blinds are made of striped linen tick, working up and down in cases, and when let down they project forward so as to admit air to the window at the bottom only. The *Heliocene* is made of similar material, but being formed in a series of hoods one above the other, it affords a shelter from the sun's rays without concealing the view from persons within; it also admits the air to every part of the window, and may be drawn up or down at pleasure.

All these blinds are valued by the foot superficial, according to the measurement of window covered by them; if the window is less than 20 feet in area, the blind is charged as 20 feet.

LIFTS are mechanical contrivances, whereby persons or goods can be raised or lowered from one story of a building to another. A common form of lift consists of a winding drum or pulley, over which is passed a rope or chain, to one end of which is attached the *cage* in which the articles to be raised or lowered are placed; and the other end is connected with a balance-weight rather heavier than the

weight of the cage when empty. The winding pulley is made to revolve by means of gearing which may be driven either by manual labour exerted upon an endless rope, or by a strap moved by steam power which can be moved off and on to the revolving drum by means of a lever to which a cord is attached; a break is also applied, to prevent the cage from falling beyond the proper place. The cage moves within a framework formed of four uprights or guides which keep it in its place, and prevent it from swaying to and fro during its ascent or descent.

HYDRAULIC LIFTS are those in which the pressure of water is the raising power applied to the cage. These are frequently used in warehouses, factories, hotels, and other large establishments. The essential feature in these lifts is a good supply of water in a tank placed in the highest part of the building; when this is secured, its application to lifts is more convenient than that of any other force, since it is always available by the simple act of opening a cock or valve, as long as the supply of water remains in the tank. The construction of these lifts is as follows: a long plunger or ram of cast-iron is fitted accurately into the stuffing-box of an iron cylinder which is sunk in the ground and firmly bedded; water is brought into the cylinder from the tank by one pipe and carried off by another. On the top of the plunger is fixed a strong cast-iron plate forming the bottom of the ascending cage, which is constructed of a wrought-iron frame, and may be filled in with wood or glass if used for a passenger

lift. At the top and bottom of the frame are two brass V-shaped guides which work against two cast-iron A-shaped guide bars placed perfectly upright. A counterbalance weight slides in a shaft separated for that purpose. There is a contrivance for regulating the speed of the lift, which would otherwise vary according to the weight placed in it. By opening a valve the water is let into the cylinder and causes the piston to rise, carrying the cage up with it; as the water is let out of the cylinder the piston and cage descend; and since water is incompressible, the moment the valve is closed so as to shut out the supply of water, the lift comes to a stand-still.

MEASUREMENT OF THE OBSTRUCTION OF ANCIENT LIGHTS.

The term 'Ancient light' is a legal phrase, applied to a window which has enjoyed a certain *amount of light* for an uninterrupted term of at least twenty years. If an adjoining owner should erect any building that would seriously diminish that *amount of light*, the owner of the window so obstructed may compel him to desist, if he can show that there will be an insufficiency of light thereto after the new building is erected. The business of the surveyor is to determine with tolerable accuracy the actual amount of light that will be abstracted by the proposed obstruction, and the proportion which it bears to the previous quantity received by the window.

In estimating the light received by a window, direct sunlight is left entirely out of consideration; the light being supposed to be derived from the quarter-sphere of sky-surface which is seen from a vertical window, if no obstacles are placed in front or on the side. In the system of measurement which gives the most exact approximation to a correct result, the sky-surface seen from the window is represented by an illuminated quarter-sphere, divided by parallel circles of latitude and vertical circles of longitude into a number of segments, each of which measures 10° vertical and 10° horizontal; and the relative value of the light from each segment, as seen from the window at the centre of the sphere, can be found by mathematical calculation, and figured upon a table divided in the same manner as the sphere. When it is required to find how much light is cut off from the window by any proposed erection, the vertical and horizontal distances thereof from the window are measured, and also the angle which its direction makes with the plane of the window; by this means the number of segments of sky-surface which are obscured can be readily seen, and a simple addition of the values of those segments enables the surveyor to compare the light lost with that obtained from the whole sky-surface.

The method by which the Table of values of the segments is calculated is as follows: when light enters horizontally through a window, a certain amount of the side light is cut off by the thickness of the wall, amounting in ordinary windows to about

10° on the extreme right and left, so that the part of the sky within 10° on each side of the plane of the window may be considered as valueless. The parts of the sky which are opposite the window give a greater amount of light for a given area of sky-surface than those which are near the sides, the quantity decreasing with the angle at which the light enters. The same holds good with respect to light coming into the window at a vertical angle, the thickness of the wall cutting off entirely the upper 5° of sky-surface; and on account of the obliquity of the rays, the value for equal areas is much less for sky-surface near the zenith than for that which is lower down and more nearly opposite the window. We must also consider the diminution of the areas of the several zones of sky-surface as they approach the zenith. Combining all these measurements, we obtain the following Table of the values of the several parts of the sky-surface measured from meridian to the extreme right or left; one half the quarter-sphere only being represented, as the other half is exactly the same. In this Table the amount of light emitted from *every* square unit of sky-surface is assumed to be the same; this being the hypothesis upon which most surveyors ground their calculations:—

TABLE *of the Relative Values of Light entering a Vertical Window from different parts of the Sky-surface, on the hypothesis of an* equal *diffusion of Light.*

		ZENITH.								
Value of each zone	80°	N. 0	0	0	0	0	0	0	0	0
54·4	70°	A 11	10·4	9·4	8	6·6	5	3	1	0
174	60°	I 35·5	33·3	30	26	21	15·4	9·6	3·2	0
335·6	50°	D 68·4	64	58	50	41	29·5	18·5	6·2	0
544	40°	I 111	104	94	81	66	48	30	10	0
748·1	30°	R 153	143	130	111·5	91	66	39·6	14	0
944	20°	E 195	180	163	140	114	83	52	17	0
1088	10°	M 222	208	188	162	132	96	60	20	0
1177	0°	240	225 H	204 O	175 R	143 I	104 Z	65 O	21 N.	0
			10°	20°	30°	40°	50°	60°	70°	80°

5065 = total value of half sky-surface.

The assumption that the illuminating power of sky-surface is everywhere the same for equal areas, whether near the horizon or near the zenith, is not in accordance either with theory or experiment, although convenient as a basis for calculation. The light obtained from the upper zones of the sky is very much more valuable than that from the lower parts for *equal areas*, and its illuminating power ap-

pears to increase according to the *sine* of the angle of altitude. The following Table has been calculated upon this hypothesis, and can be applied in the same manner as the one on p. 340 :—

TABLE *of the Relative Values of Light entering a Vertical Window from different parts of the Sky-surface, on the hypothesis of a* variable *diffusion of Light.*

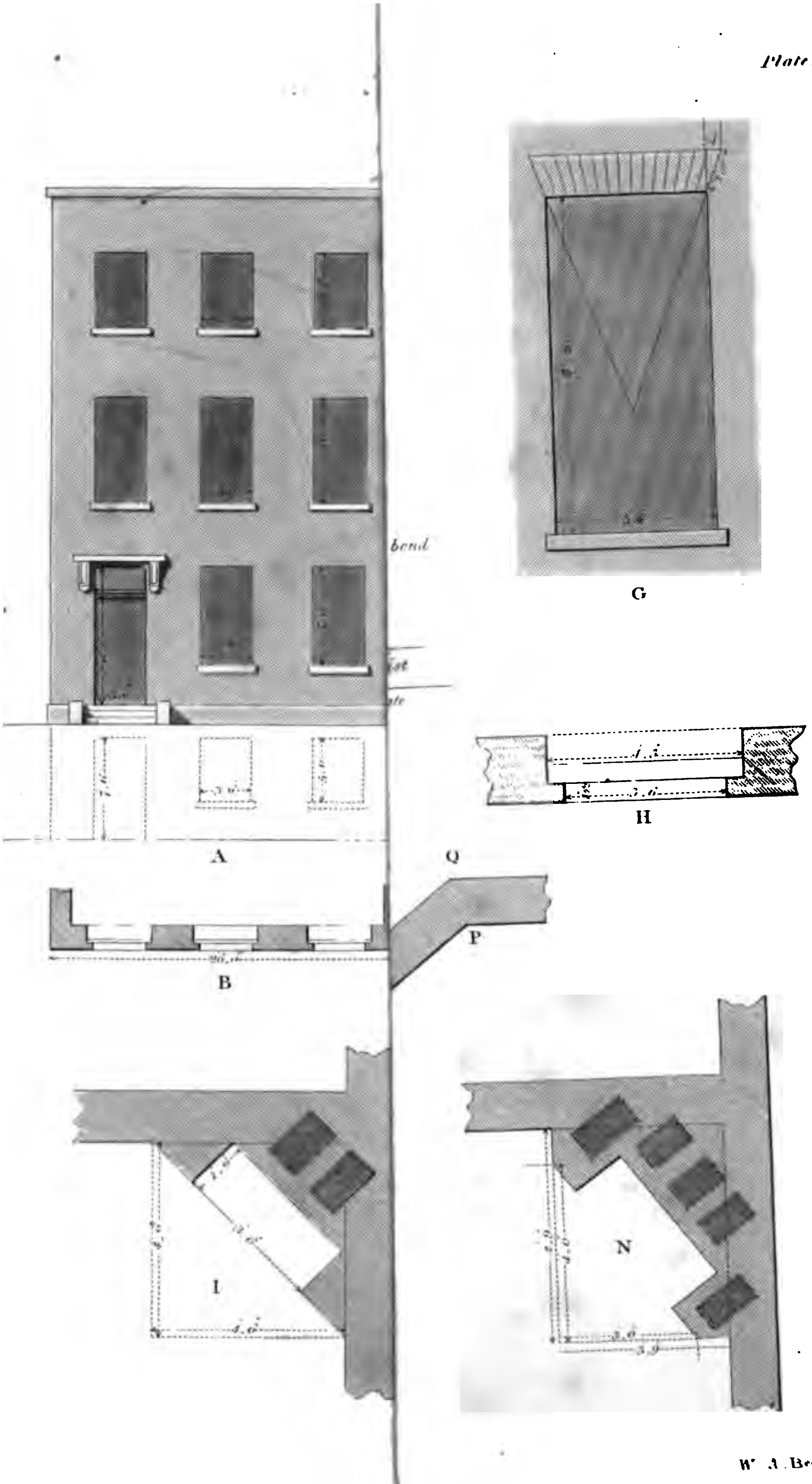
ZENITH											
Value of each zone	80°	N.	0	0	0	0	0	0	0	0	0
54·4	70°	A	11	10·4	9·4	8	6·6	5	3	1	0
157·5	60°	I	32·6	30·5	25	24	19·4	14	9	3	0
273·3	50°	D	56	52	47	41	33·3	24	15	5	0
387·9	40°	I	79	74	67	58	47	34·4	21·5	7	0
431	30°	R	88	82	75	64	52	38	24	8	0
397·3	20°	E	81	76	69	59	48	35	22	7·3	0
294·6	10°	M	60	56	51	44	36	26	16·3	5·3	0
104	0°		21	20	18	15	13	9	6	2	0
				H	O	R	I	Z	O	N.	
			10°	20°	30°	40°	50°	60°	70°	80°	

2100 = total value of half sky-surface.

The numbers in the first column on the left of each Table represent the total value of each zone from 0° up to 90°, or for *half* the quarter-sphere of sky-surface; these numbers must therefore be doubled

to obtain the value of the whole zone from extreme right to extreme left. The number at the bottom of the first column represents the sum-total of all the values of the several zones of the *half* quarter-sphere, and by comparing the value of light abstracted by any obstruction with the *total*, we are enabled to see at once what proportion of the whole of the light from the sky-surface is destroyed thereby.

Plate I.



W. A. Beever.

Plate. 2

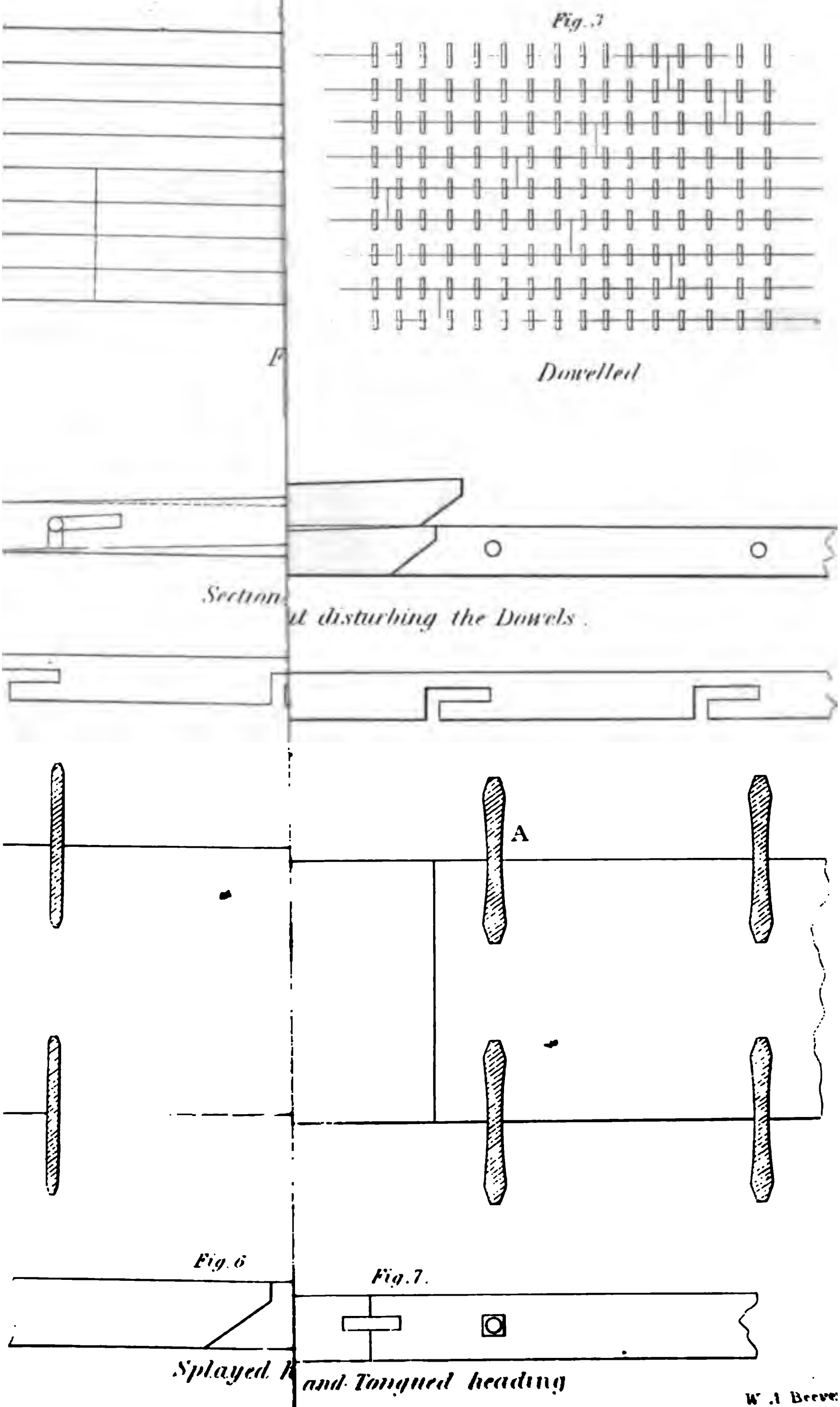


Fig. 3
Dowelled
F
Section
ut disturbing the Dowels.
A
Fig. 6
Fig. 7.
Splayed
and Tongued heading
W. A. Beeve

Plate. 2

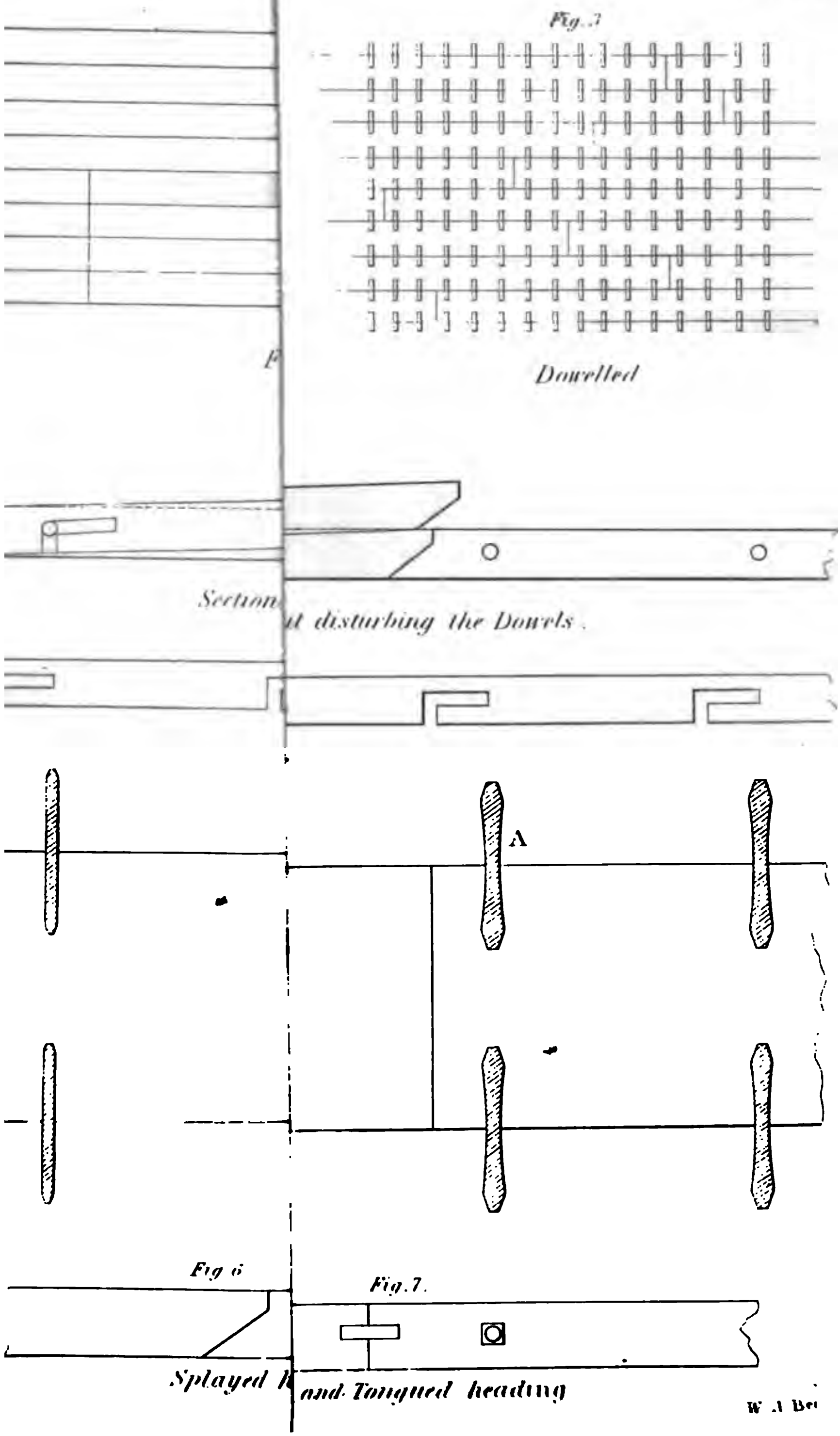
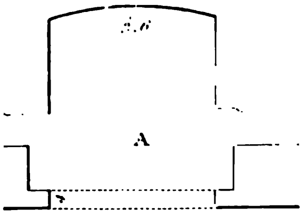


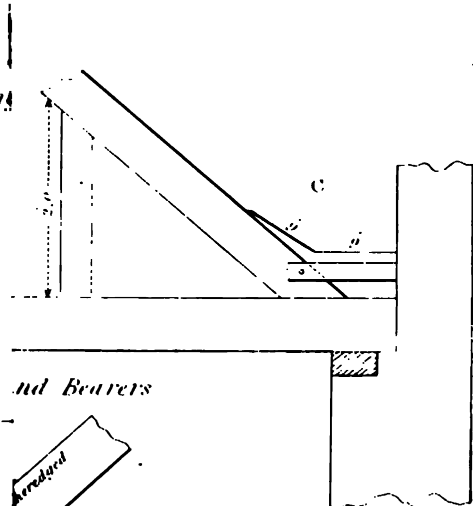
Fig. 3
Dowelled
disturbing the Dowels.
A
Fig 6
Fig. 7.
Splayed
and Tongued heading

Plate 3.

Centering

Fig. 1.





and Bearers

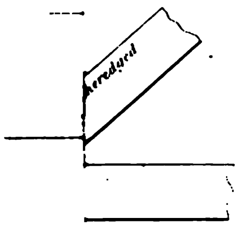
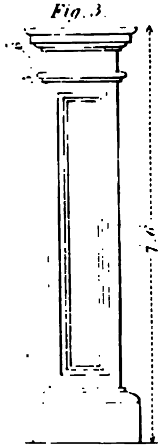
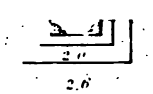
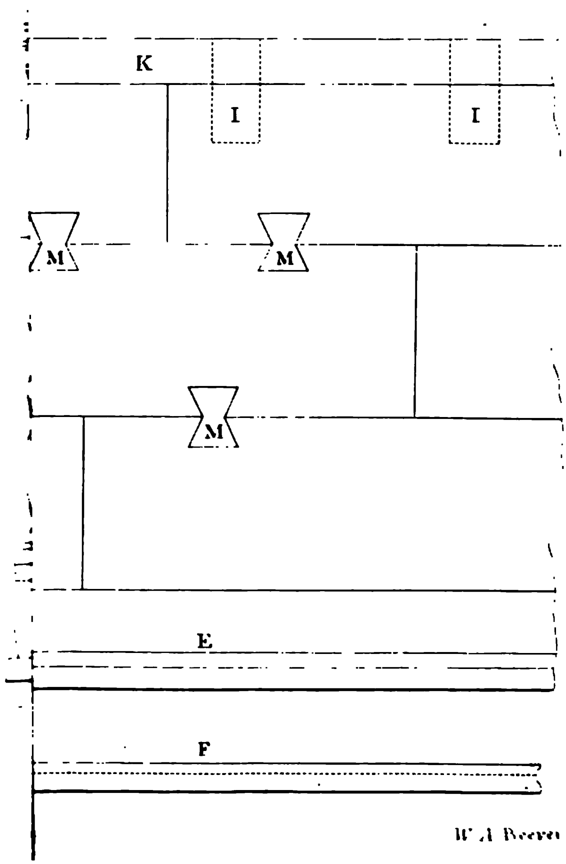


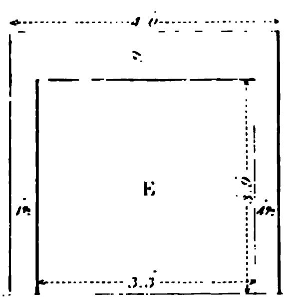
Fig. 3.



Pilaster







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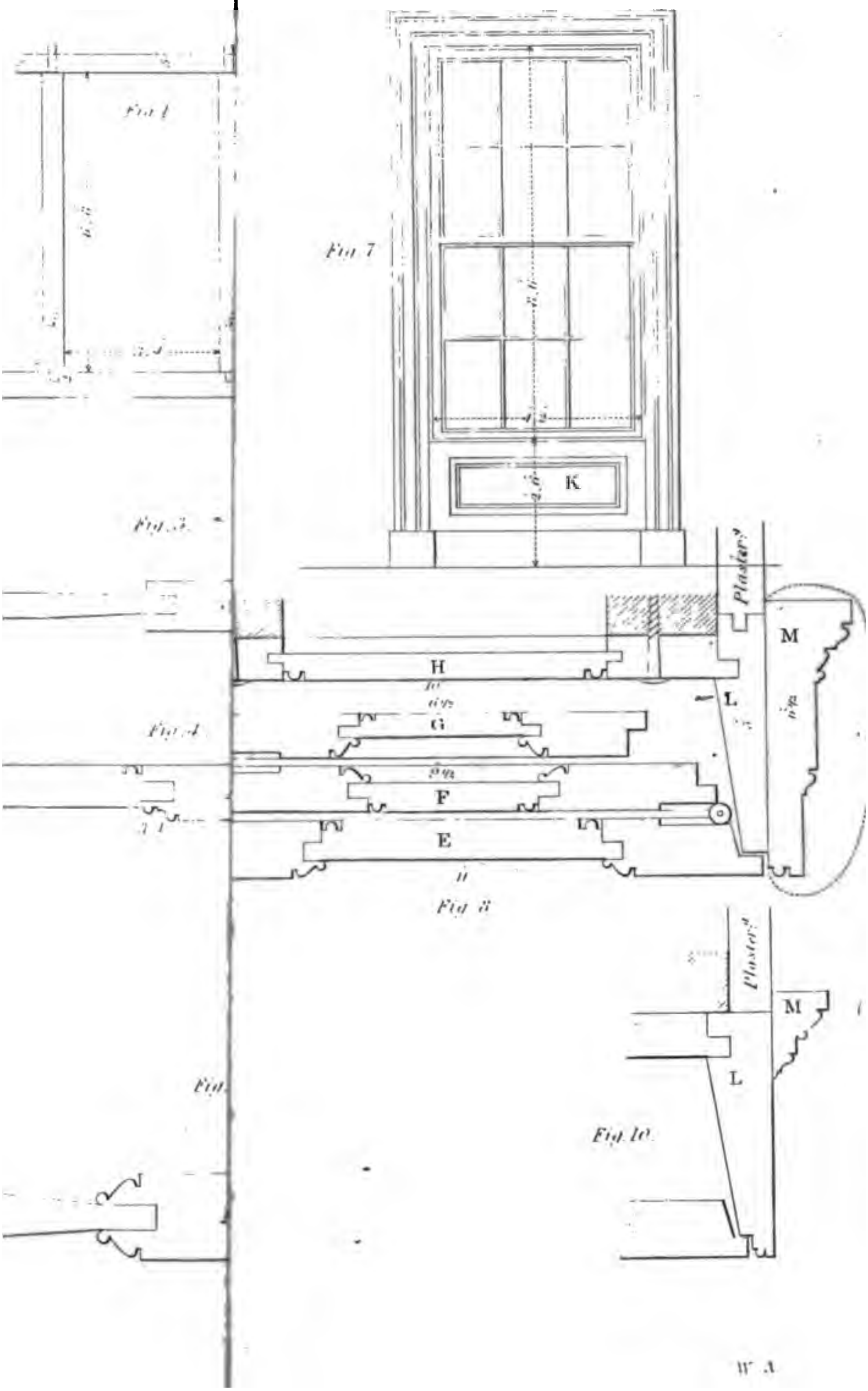
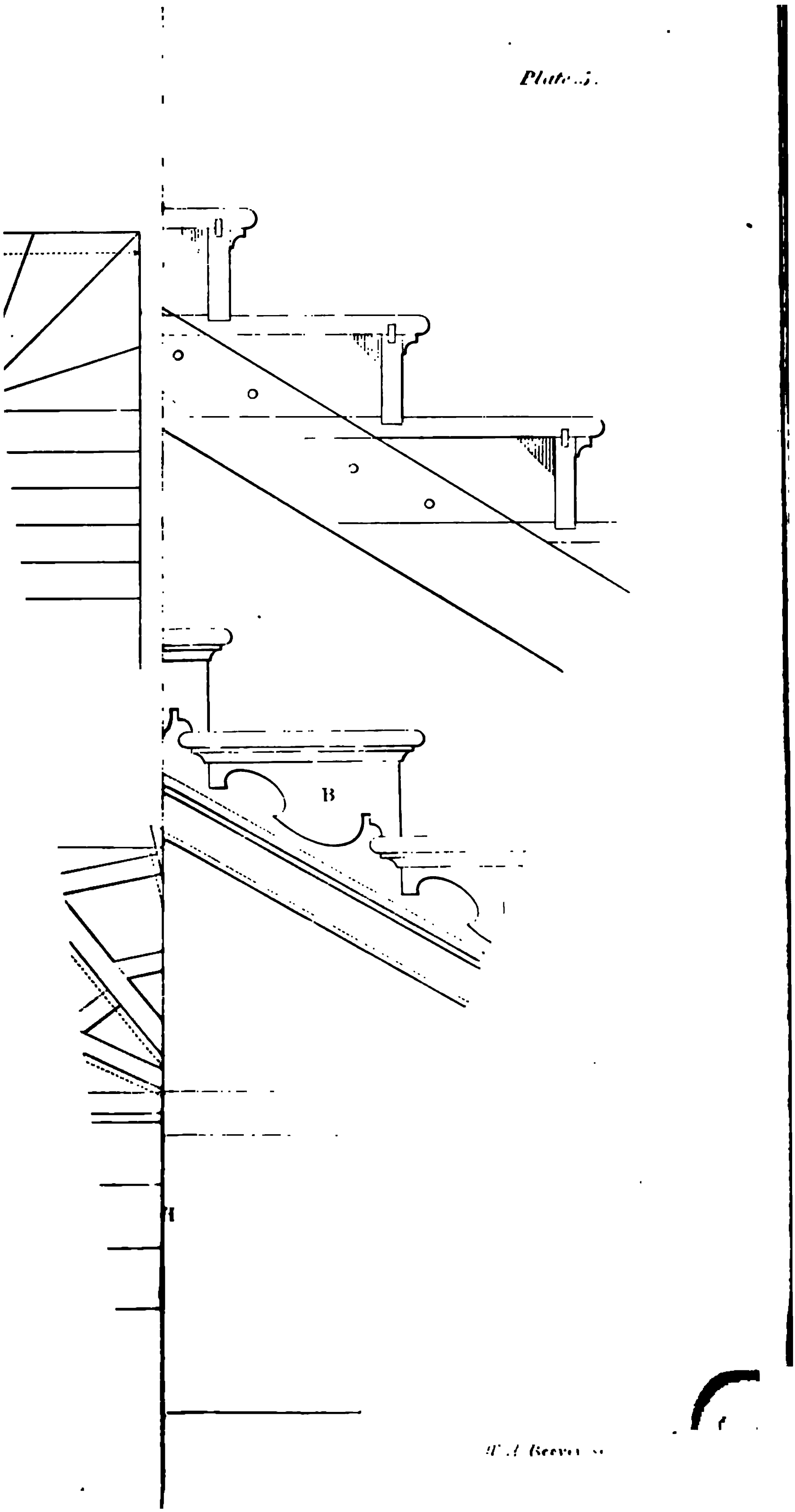
W. A. Beevers sc.

Do[...] Sashes and Frames, Shutters &c.





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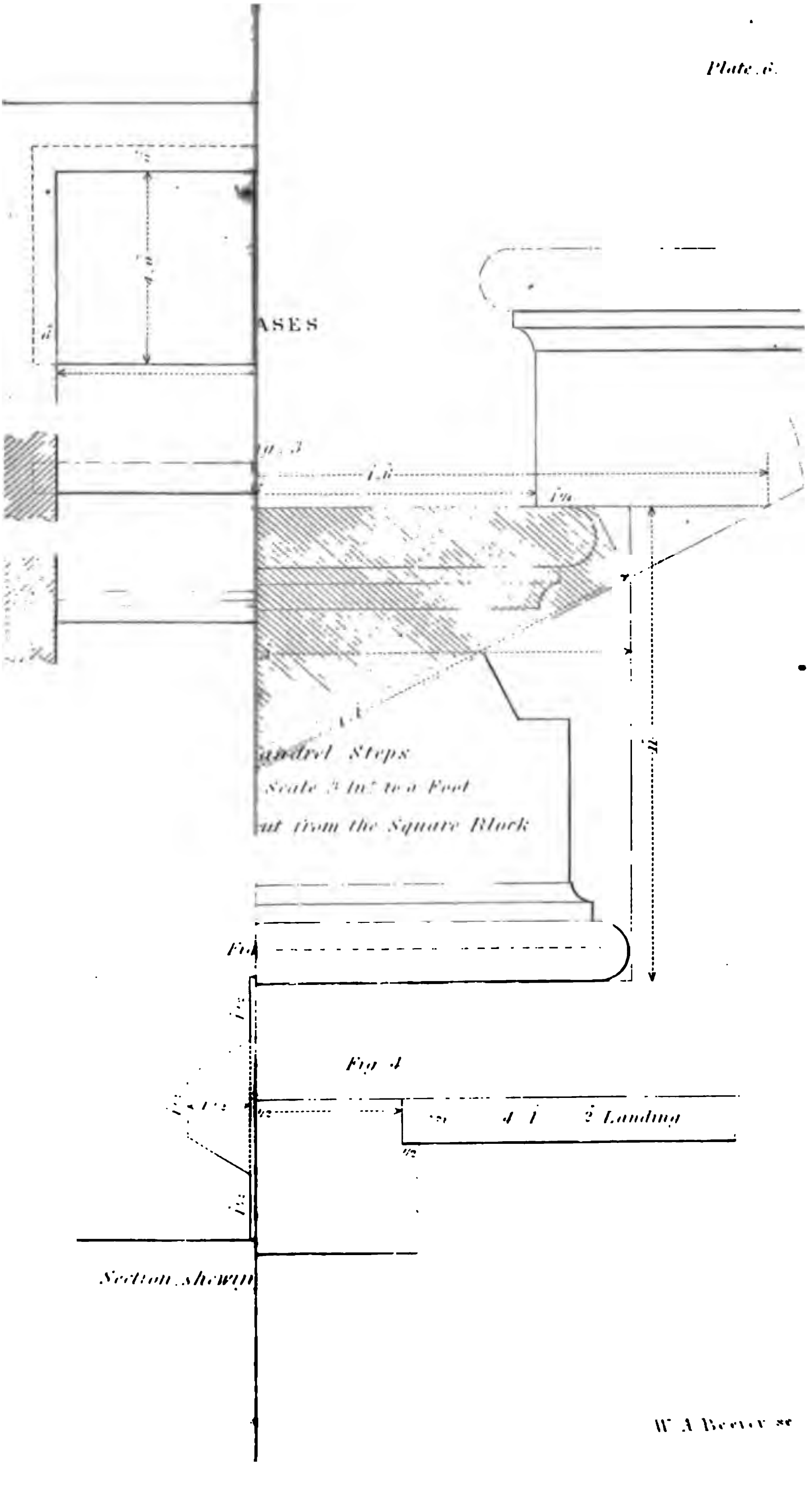
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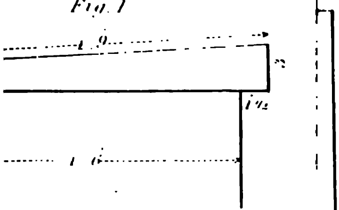
Fig. 4
4 1 2 Landing
Section shewin

W. A. Beever sc.

Plate 7.

Fig. 1.



Coping

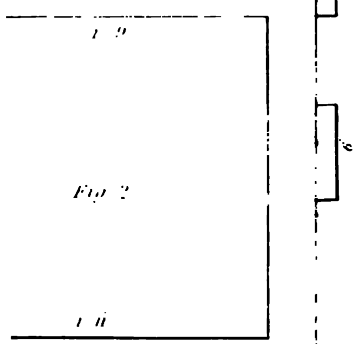
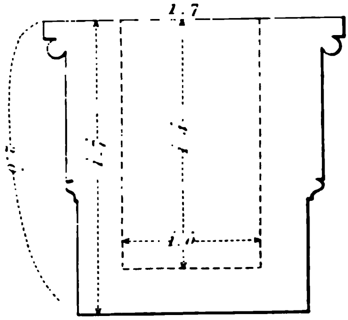


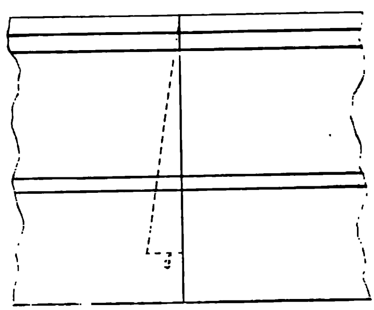
Fig. 2

Plan of Quoin

Fig. 10.

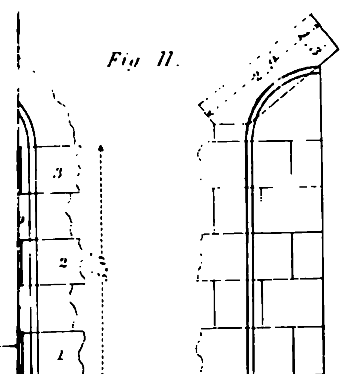


Section of Architrave



Elevation of Architrave

Fig. 11.



Section

Fig. 3

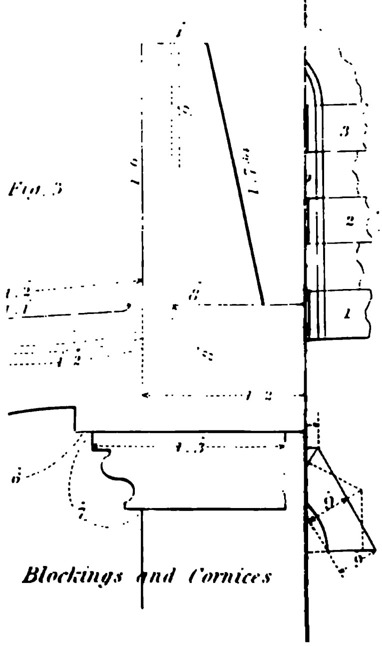


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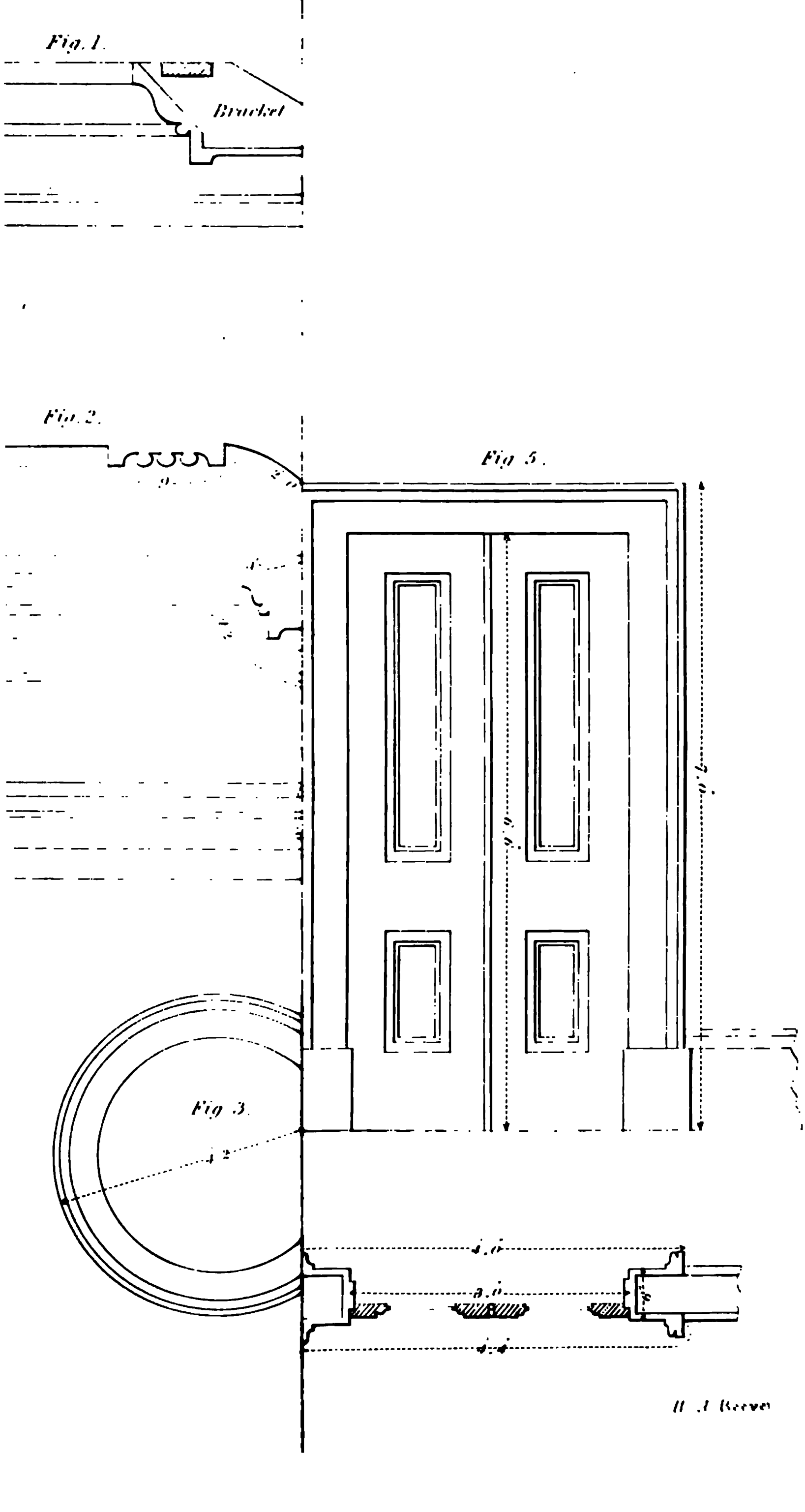
Plate 8.



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